REMEDIAL INVESTIGATION / FEASIBILITY STUDY
FIELD SAMPLING PLAN ADDENDUM No. 1a

Falcon Refinery Superfund Site
Ingleside
San Patricio County, Texas
TXD 086 278 058

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*Due to the size of these appendices, they are not included in this Addendum No. 1a. These can be found in full in Field Sampling Plan Addendum No. 1, prepared by Kleinfelder.

ABBREVIATIONS AND ACRONYMS

API	American Petroleum Institute
AOC	Area of concern
ARAR	Applicable or Relevant and Appropriate Requirements
BG	Background
bgs	Below Ground Surface
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COPC	Chemical of Potential Concern
COPEC	Chemical or Compound or Contaminant of Potential Ecological Concern
CSM	Conceptual Site Model
DQO	Data Quality Objective
DTW	Depth to Water
EB	Equipment Blank
EPA	U.S. Environmental Protection Agency
ERA	Ecological Risk Assessment
FS	Feasibility Study
FSP	Field Sampling Plan
G	Grid Sample
gpm	Gallons Per Minute
GPS	Global Positioning System
HHRA	Human Health Risk Assessment
HRS	Hazard Ranking System Documentation Record, Falcon Refinery
IDW	Investigation-Derived Waste
J	Judgmental Sample
MD	Matrix Duplicate
µg/L	Microgram per Liter
µg/kg	Microgram per Kilogram
mg/kg	Milligram per Kilogram
MS	Matrix spike
MSD	Matrix spike duplicate
MSSL	Medium-specific Screening Level
MW	Permanent Monitor Well
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
NORCO	National Oil Recovery Corporation
NPL	National Priorities List
OU	Operating Unit
PCB	Polychlorinated Biphenyl
PCL	Protective Concentration Limit
PID	Photoionization Detector
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control

QAPP	Quality Assurance Project Plan
QC	Quality Control
RA	Removal Action
RAW	Removal Action Work Plan
RBSL	Risk Based Screening Level
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RPM	Remedial Project Manager
S	Soil Sample
SD	Sediment Sample
SOP	Standard Operating Procedure
Superior	Superior Crude Oil Gathering
SVOC	Semi-Volatile Organic Compound
SW	Surface Water Sample
TB	Trip Blank
TCEQ	Texas Commission on Environmental Quality
TCLP	Toxicity Characteristic Leaching Procedure
TNRCC	Texas Natural Resources Conservation Commission
TPH	Total Petroleum Hydrocarbons
TRV	Toxicity Reference Value
TW	Temporary Monitor Well
UCL	Upper Confidence Level
USCS	Unified Soil Classification System
VOC	Volatile Organic Compound
VSP	Visual Sample Plan
WBZ	Water Bearing Zone

To the best of my knowledge, after thorough investigation, I certify that the information contained in or accompanying this submission is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

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1.0 INTRODUCTION

The following Field Sampling Plan (FSP) Addendum, prepared by TRC, on behalf of National Oil Recovery Corporation (NORCO), utilizes the results of Phase I sampling and defines the sampling and data gathering methods to be used to define the nature and extent of contamination and human and ecological risk for Phase II at the former Falcon Refinery located near Ingleside, San Patricio County, Texas (Figure 1). Specifically, the FSP will include Phase II sampling objectives, sample locations and frequency, sampling equipment and procedures and sample handling and analysis. All work will be performed in compliance with the U.S. Environmental Protection Agency's (EPA) guidance document titled, *Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA.*

Field sampling activities related to the disposal of on-site hazardous materials (referred to as the Removal Action (RA)) at the former Falcon Refinery site will be performed in accordance with the approved FSP dated August 24, 2007.

The Quality Assurance Project Plan (QAPP) and QAPP Addendum are companion documents to this FSP Addendum and provide information concerning the rationale for the sampling strategy, laboratory procedures and the Quality Assurance/Quality Control (QA/QC) procedures to be employed in this FSP Addendum.

Section numbering in this report is similar to the numbering in the FSP. Only sections that require updating or pertain to Phase II are included.

1.1 Phase II Investigation Overview

Described in this section is the Phase II assessment plan for this FSP Addendum. Details of the methodologies used to perform the activities are described in the Standard Operating Procedures (SOP) provided in Appendix E of this FSP Addendum.

For Phase I, the number of soil, sediment, groundwater, and surface water judgmental or random grid sampling locations were initially determined by the Site Team and were not based on the distribution of constituents, if any, at the site. Phase I helped to determine the distribution of constituents at the site and served as the basis for this FSP Addendum.

When the data from Phase I were obtained and analyzed, the standard deviation, alpha and beta error rates, width of the gray region, and a threshold value (screening value) were then used in Phase II as input into Visual Sample Plan (VSP) software algorithms to statistically determine the minimum number of samples required to meet the Data Quality Objectives (DQO) for the site.

For human health and ecological risk assessment screening purposes, any chemicals detected at the site above their respective screening levels will be carried forward in the risk assessments required by the National Contingency Plan (NCP), taking into account synergistic effects. For ecological risk assessment screening purposes, bioaccumulative chemicals may need to be carried forward in the risk assessment if found below their respective screening levels.

For both the human health and ecological risk assessments, the maximum detected concentrations will be used for risk screening purposes. The statistically derived 95% upper confidence limit (UCL) of the arithmetic mean (if the sample size is adequate) or maximum concentration (if the sample size is inadequate), whichever is appropriate for a given medium, will be calculated for use as the concentration term in the risk assessment equations following the risk screening process. The statistical methods described in EPA guidance documents for calculating UCLs are based on the assumption of random sampling.

1.1.1 Phase I On-Site Investigation

The following on-site Phase I sampling activities were performed:

- Collected judgmental surface and subsurface soil samples at former operating units (OU) at the north and south sites using a Geoprobe and/or hand sampling device;
- Collected random start grid composite surface and subsurface soil samples from areas of the site not associated with former OUs using a Geoprobe; and
- Installed and sampled temporary monitor wells using a Geoprobe at locations with the highest probability of groundwater impacts. The temporary monitor wells were abandoned prior to demobilization from the site.

1.1.2 Phase I Off-Site Investigation

The following off-site Phase I sampling activities were performed:

- Collected judgmental sediment, surface and subsurface soil samples at background locations in areas located outside the area of probable impact from the site, in similar settings to those being evaluated;
- Collected judgmental surface and subsurface soil at residential locations adjacent to the site;
- Collected random start grid sediment samples in the wetlands;
- Collected judgmental sediment and surface/subsurface soil samples along the active and inactive pipelines leading to the current and former barge dock facilities; and
- Sampled surface water in the wetlands and bay adjacent to the site.

Provided as Appendix A (due to size, please refer to Field Sampling Plan Addendum No. 1 prepared by Kleinfelder) are figures showing the analytical results of the Phase I sampling and analysis. Data are presented by 1) area of concern (AOC), 2) matrix (groundwater, surface soil, subsurface soil, sediment and surface water), 3) analytical group (metals, volatile organic compounds (VOC) and semi-volatile organic compounds (SVOC) and 4) analysis type (comparison to human health criteria or ecological criteria). Figures are also provided for background sampling.

Mapping criteria included listing chemicals of potential concern (COPCs) having either a single detection above an applicable screening value or a method detection limit above an applicable screening value.

Provided as Appendix B (see Field Sampling Plan Addendum No. 1) are the analytical results of the Phase I sampling.

1.2 Phase II Investigation

When the data from Phase I were obtained and analyzed, the standard deviation, alpha and beta error rates, width of the gray region, and a threshold value (benchmark human health or ecological screening value) were used in Phase II as input into VSP software algorithms to statistically determine the minimum number of samples required to meet the DQO for the site.

For the VSP evaluation of the minimum number of samples required to meet the DQOs for the site, an alpha error rate of 5% and a beta error rate of 10% were selected to balance the costs of additional samples against the usefulness of additional data for site management decisions. The analyte mean was assumed to be greater than the screening levels (i.e., site assumed to be "dirty"). The analyte standard deviation for each AOC media was used. Due to the nature of the data and analyte screening levels, the data was evaluated using two methods for identifying the width of the gray region (delta) and are described below:

Method 1 calculated delta is the difference between the analyte mean concentration and the screening value. This delta is useful for calculating the number of samples necessary to differentiate between the analyte mean and the screening value. However, when the difference between the mean and the screening value is less than the analyte standard deviation, a very large minimum sample number will be calculated. This method of calculating delta is described in *Guidance on Systematic Planning Using the Data Quality Objective Process*, EPA QA/G4, February 2006, available at http://www.epa.gov/QUALITY/qs-docs/g4-final.pdf. In this case, the screening value less the delta value can be described as the concentration above which decision makers will accept actually "clean" sites will be misclassified as "dirty".

Method 2 delta is calculated independently of the analyte mean as a fraction of the screening value. This type of delta is useful for calculating the sample quantity necessary to differentiate an analyte mean from the screening value when only the analyte standard deviation can be reasonably predicted. However, when delta is less than the standard deviation, a very large minimum sample number will be calculated. For the purpose of evaluating Phase I data for the site, the delta was calculated as one half of the screening value. The range of appropriate values for Method 2 delta is given in the VSP User Guide as 0.2 to 0.95 of the screening value (Visual Sample Plan Version 5.0 User's Guide, September 2007, page 3.7). In this case, delta can be described as the fraction of the screening value above which decision makers will accept actually "clean" sites will be misclassified as "dirty".

Analyte data judged acceptable for minimum sample number calculation in VSP were those with at least four detected concentrations in an AOC media. For example, if at least four detected concentrations were present in AOC-1 Surface Soil, the analyte was evaluated for minimum sample number in AOC-1 Surface Soil. If the analyte was not detected at least four times in AOC-1 Subsurface Soil, it was not evaluated for minimum sample number in that media.

Analytical data flagged with "B", indicating it was detected in analytical blanks, was conservatively evaluated at the reported value without reference to if the analyte was a commonly detected laboratory contaminant or not. Analytical data flagged with "J" or not flagged were evaluated with the reported value. Analytical data flagged with "U", indicating it was not detected at the reported concentration, were divided by two prior to evaluation. Duplicate samples whether detected or not were evaluated at their average concentration, after adjustment for U-flagged values.

The VSP reports of minimum sample size calculations for each AOC media with analytes detected at least four times are presented as Appendix C (see Field Sampling Plan Addendum No. 1). Because of formatting limitations within the VSP report function, refer to the beginning of Appendix C for an index of each report's applicable AOC, media, and delta method. Note the VSP software contains at least two errors in its reporting function impacting this work. The most significant error assigns potential new sample locations a concentration of zero for the first analyte listed in the table of analyte screening values prior to calculating the specific analyte's summary statistics for the report. Therefore an "analyte" named "New Location" was entered at the top of the table as a work-around enabling the VSP report to accurately calculate and present subsequent analyte summary statistics[1]. Tables detailing the results of each VSP evaluation are presented as Appendix D (see Field Sampling Plan Addendum No. 1). Appendix D tables present brief summary statistics for each analyte evaluated, the minimum sample quantities calculated by VSP using Method 1 and Method 2 deltas, sample quantities based upon best professional judgment arrived at after further review of the data, and the proposed number of samples to be collected. Table 2 presents a summary of Appendix D proposed sample quantities for each AOC media during Phase II.

For human health and ecological risk assessment screening purposes, COPCs detected at the site above their respective screening levels will be carried forward in the risk assessments required by NCP, taking into account synergistic effects. For ecological risk assessment screening purposes, bioaccumulative chemicals may need to be carried forward in the risk assessment if found below their respective screening levels.

[1] The second software error to impact this work occurs when areas within an AOC contain the same existing sample location (i.e. areas overlap). This results in the report double-counting data from a location and inaccurate summary statistic values. The work-around used was to merge all areas in an AOC prior to data entry. As a courtesy, VSP technical support personnel have been notified of these two software errors and the work-around used for each.

For both the human health and ecological risk assessments, the maximum detected concentrations will be used for risk screening purposes. The statistically derived 95% UCL of the arithmetic mean (if the sample size is adequate) or maximum concentration (if the sample size is inadequate), whichever is appropriate for a given medium, will be used as the exposure point concentration term during risk assessment following the screening process. The ProUCL software available from EPA will be used to calculate the concentration term (Version 4.0, dated April 2007, available at http://www.epa.gov/esd/tsc/software.htm). The statistical methods described in EPA guidance documents for calculating UCLs are based on the assumption of random sampling.

1.2.1 Phase II On-Site Investigation

- Additional surface and subsurface soil sampling;
- Installation of permanent monitor wells;
- Additional groundwater sampling; and
- Characterization of aquifer properties.

1.2.2 Phase II Off-Site Investigation

- Additional sediment sampling in the wetlands and bay;
- Biota sampling;
- Additional surface water sampling;
- Additional surface and subsurface soil sampling; and
- Installation of off-site monitor wells and groundwater sampling.

1.3 Sampling Objectives and Design

This FSP Addendum is based on site-specific DQOs developed from the comprehensive conceptual site model (CSM) and based on EPA and TCEQ guidance documents. EPA's DQO process is an important tool for defining the type, quality, and quantity of data needed to make defensible decisions.

The DQO approach, discussed in the approved FSP, will be followed in this Addendum. Section A7 of the Falcon Refinery QAPP presents the DQOs developed for the Falcon Refinery Remedial Investigation (RI).

During Phase II sampling, newly acquired analytical data will be evaluated to determine if sufficient data have been obtained which meet the sampling and data DQOs for the site. If the objectives have not been met, additional mobilizations and sampling will be presented.

2.0 CONCEPTUAL SITE MODEL

The purpose of the CSM is to identify pathways for COPC transport and potentially impacted media and receptors. In preparing the CSM, data gaps were identified based on the data needs for defining nature and extent of COPCs, conducting the Ecological Risk Assessment (ERA) and Human Health Risk Assessment (HHRA) and evaluating presumptive remedies for the site, if needed. Site-specific DQOs were developed based on the CSM and were subsequently used to develop the QAPP and FSP for the site.

2.1 Physical Profile

The Falcon Refinery site consists of a refinery which operated intermittently and is currently inactive. When in operation, the refinery had a capacity of 40,000 barrels per day and the primary products consisted of naphtha, jet fuel, kerosene, diesel, and fuel oil.

Further specific descriptions of the physical profile are provided in Section 2.1 of the FSP.

2.2 Areas of Concern

Seven areas of concern (AOC) have been identified as potential areas impacted by COPCs. Three AOCs are identified on-site and four are off-site. AOCs are summarized in Table 1 and shown on Figure 2**.** Each AOC is discussed in detail in Section 2.2 of the FSP.

For the purposes of this Phase II investigation, soil sample intervals will be divided into surface and subsurface soil. Surface soil is soil existing at a depth of 0.0 to 0.5 feet below ground surface (bgs). Subsurface soil includes all depths below 0.5 feet bgs.

2.2.1 AOC-1 Former Operational Units (OU)

Included in AOC-1 are: the entire North site; former OU areas of the South site; a drum disposal area; and an area where metal waste was discarded.

Preliminary COPCs to be screened at this AOC included metals, VOCs, SVOCs, polychlorinated biphenyls (PCBs) and pesticides/herbicides.

Potentially affected media include soil and groundwater.

Reports outlining the VSP-calculated minimum sample sizes with human health or ecological screening values as the benchmarks and using both delta methods are presented as Appendix C: Reports 1 through 4 correspond to AOC-1 surface soils; Reports 5 through 8 correspond to AOC-1 subsurface soils; and Reports 9 and 10 correspond to AOC-1 groundwater.

Detailed summary tables of the VSP calculations are presented as Appendix D: Table D-1 corresponds to AOC-1 surface and subsurface soils with human health screening value benchmarks; Table D-2 corresponds to AOC-1 surface and subsurface soils with ecological screening value benchmarks; and Table D-3 corresponds to AOC-1 groundwater with human health screening value benchmarks.

2.2.2 AOC-2 On-Site Non-Operational Areas

Included in AOC-2 are areas of the refinery not used for operations or storage and have no record of releases.

Although no COPCs were anticipated in AOC-2, the screened COPCs included metals, VOCs and SVOCs.

Potentially affected media include soil and groundwater.

Minimum samples size calculations were not performed for composite samples collected during Phase I. The minimum sample quantity necessary for AOC-2 was evaluated using best professional judgment based upon review of site history and analytical results for the composite samples.

2.2.3 AOC-3 Wetlands

Included in AOC-3 are 1) wetlands immediately adjacent to the site bordered by Bay Avenue, Bishop Road and a dam on the upstream side, 2) wetlands located between Bishop Road, Sunray Road, Bay Avenue and residences along Thayer Avenue and 3) wetlands between Sunray Road, residences along FM 2725, Gulf Marine Fabricators, Offshore Specialty Fabricators and the outlet of the wetlands into the intracoastal.

There is one active and several abandoned pipelines leading from the refinery to the current and former barge dock facilities. During June 2006, the abandoned pipelines were cut, the contents of the pipelines were removed and plates were welded on the pipeline ends to seal them. These activities were performed under the Remedial Action Work Plan (RAW).

Wetland assessment activities will evaluate releases from the refinery, including any unpermitted wastewater effluent discharges, two known pipeline releases, and possible releases from pipelines leading from the refinery to the current and former barge dock facilities.

There have been documented spills of hydrocarbons, waste and volatile organics. As a result, the screened COPCs at this AOC included metals, VOCs, SVOCs, PCBs, herbicides and pesticides.

Potentially affected media include sediment, soil, surface water and groundwater.

Reports outlining the VSP-calculated minimum sample sizes with human health or ecological screening values as the benchmarks and using both delta methods are presented as Appendix C:

Reports 11 through 14 correspond to AOC-3 surface soils; Reports 15 through 18 correspond to AOC-3 subsurface soils; Reports 19 through 22 correspond to AOC-3 surface water; and Reports 23 through 26 correspond to AOC-3 sediments.

Detailed summary tables of the VSP calculations are presented as Appendix D: Table D-4 corresponds to AOC-3 surface and subsurface soils with human health screening value benchmarks; Table D-5 corresponds to AOC-3 surface and subsurface soils with ecological screening value benchmarks; Table D-6 corresponds to AOC-3 surface water with human health and ecological screening value benchmarks; and Table D-7 corresponds to AOC-3 sediments with human health and ecological screening value benchmarks.

2.2.4 AOC-4 Current Barge Docking Facility

Included in AOC-4 is the current barge docking facility, which is approximately 0.5 acres and is located on the intracoastal waterway. The fenced facility, which is connected to the refinery by pipelines, is used to load and unload barges. At the time of this report only crude oil passed through the docking facility. Historically however, refined products were also loaded and unloaded at this docking facility.

There have been no reported releases nor is there evidence of spills associated with this AOC. The screened COPCs at this AOC included metals, VOCs, SVOCs, PCBs and pesticides/herbicides.

Potentially affected media include soil and groundwater.

Minimum samples size calculations were not performed for composite samples collected during Phase I. The minimum sample quantity necessary for AOC-4 was evaluated using best professional judgment based upon review of site history and analytical results for the composite samples.

2.2.5 AOC-5 Intracoastal Waterway

Included in this AOC are the sediments and surface water adjacent to the current and former barge dock facility. The screened COPCs at this AOC included metals, VOCs, SVOCs, PCBs and pesticides/herbicides.

Potentially affected media include sediment and surface water.

The three Phase I samples for AOC-5 did not qualify for statistical calculation of minimum sample size which requires at least four detected concentrations. The minimum sample quantity necessary for AOC-5 was evaluated by review of Phase I analytical data and best professional judgment.

2.2.6 AOC-6 Thayer Road

Included in this AOC is the neighborhood along Thayer Road, located across Bishop Road from the refinery.

The screened COPCs at this AOC included metals, VOCs, SVOCs, PCBs and pesticides/herbicides.

Potentially affected media include soil and groundwater.

The three Phase I samples for AOC-6 did not qualify for statistical calculation of minimum sample size which requires at least four detected concentrations. The minimum sample quantity necessary for AOC-6 was evaluated by review of Phase I analytical data and best professional judgment.

2.2.7 AOC-7 Bishop Road

Included in this AOC is the neighborhood along Bishop Road, located across Bishop Road from the North site.

The screened COPCs at this AOC included metals, VOCs, SVOCs, PCBs and pesticides/herbicides.

Potentially affected media include soil and groundwater.

The two Phase I samples for AOC-7 did not qualify for statistical calculation of minimum sample size which requires at least four detected concentrations. The minimum sample quantity necessary for AOC-7 was evaluated by review of Phase I analytical data and best professional judgment.

3.0 SAMPLING OBJECTIVES

As stated in the DQOs for this project, the following study question, included in the QAPP, was formulated for the Site RI:

- Where do preliminary COPCs exist either on- or off-site at concentrations above or below risk-based screening levels (RBSLs) and/or background concentrations along complete exposure pathways for relevant exposure scenarios?

The primary objective of the FSP sampling design is to collect data of sufficient quantity and quality to resolve the study question and support risk assessment and remedy evaluation. The field sampling design for Phase II is summarized in Table 3**.**

The goal of Phase II is to determine the nature and extent of COPCs and to identify COPC migration pathways. Data must be of sufficient quality (including acceptable reporting limits) and quantity to perform an ERA and HHRA for the site in accordance with risk assessment guidance (EPA 1991, 1997, 2000d). Additional data will be collected to support an evaluation of presumptive remedies for the site.

The field sampling design for Phase II (Table 3) is divided into activities which may be conducted concurrently:

- On-site random-start systematic grid (random grid) soil sampling to assess potential presence of COPCs of high toxicity and/or high mobility, define the nature and extent of COPCs, characterize waste to allow for disposal option evaluation in the FS, and evaluate whether COPCs are migrating off-site. The data will be used in the HHRA and ERA.
- On-site OU groundwater investigation to determine the nature and extent of groundwater COPCs. Permanent monitor well data will be used in the HHRA and ERA. Data collected during the on-site groundwater investigation will also be used to update the pathway and receptor analysis presented in the CSMs, if necessary.
- Off-site random grid wetlands and intracoastal surface water and sediment investigation to define the nature and extent of COPCs, provide data to be used in the HHRA and ERA and also be used to update the pathway and receptor analysis presented in the CSMs, if necessary.
- Off-site background surface soil, subsurface soil, groundwater, surface water and sediment investigation to provide data to be used in the HHRA and ERA.

The strategy for characterizing the site is based on site-specific DQOs, which are based on the following media-specific screening levels (MSSLs):

- EPA Region 6 human health MSSLs and TCEQ Tier 1 PCLs for human health risk screening of soil and groundwater. Groundwater ingestion pathways will only apply, upon consultation with the EPA and TCEQ, if the shallow aquifer is of sufficient yield and natural quality to constitute a potable water supply. Soil screening levels (assuming the dilution/attenuation factor of 10 as suggested by the EPA Soil Screening Level guidance document) will be used to evaluate soil-to-groundwater migration potential;

- TCEQ ecological benchmarks for ecological screening of soil, sediment and surface water;

- Texas and Federal Surface Water Quality Criteria for human health screening; and,

- Other applicable or relevant and appropriate requirements (ARARs).

A complete list of all human health and ecological screening levels (benchmarks) are provided as Appendices E and F of the FSP.

Each of the field sampling activities and the data collection requirements are discussed in the following sections.

3.1 On-Site Random Start Grid Locations AOC-1

A total of 24 random start grid sample locations (four from the North site and 20 from the South site) will be used to assess areas suspected of having had an historical release and discolored areas within former OUs (Figure 3). This area has been designated as AOC-1. The basis of decision for the proposed number of additional soil samples within AOC-1 is summarized in Table 2 with details presented as Appendix D, Tables D-1 and D-2.

There are four random start grid locations (G2-01S – G2-04S) at the North site to characterize possible COPCs in the soil as a result of releases from product storage, pipelines, the former oil and fuel storage racks, storm water run-off, the adjoining Plains site and a former surface impoundment.

There are 20 random start grid sampling locations (G2-05S – G2-24S) at the South site to characterize possible COPCs in the soil as a result of releases from product storage, pipelines, drums, debris, storm water run-off, an aeration pond and stained soil.

Due to the shallow depth of the groundwater, which was less than eight feet, two soil samples will be obtained for laboratory analysis from each boring. Samples will be obtained from the surface to 0.5 feet bgs and from the interval with the highest photoionization detector (PID) reading. In the event of no PID readings, a soil sample from the groundwater interface or at a depth of five feet will be obtained. Samples will be analyzed in a fixed laboratory for Phase I COPCs as shown in Table 3. Each boring will be advanced a minimum of five feet below the initial contact with groundwater.

3.2 On-Site Random Grid Locations AOC-2

The sampling objectives for non-OU on-site soil sampling include determining the nature and extent of COPCs and collecting sufficient data of appropriate quality to assess site risks to either human or ecological populations.

During Phase I, composite sampling was performed and only arsenic was detected above the appropriate screening level. Several constituents were analyzed below the MDL. However, the MDL exceeded screening criteria.

There are four random start grid sampling locations (Figure 4) at AOC-2 (G2-25S through G2-28S) selected by the VSP. The basis of decision for the proposed number of additional soil samples within AOC-2 is summarized in Table 2. AOC-2 is comprised of non-OU areas of the site having no history of releases. Samples will be obtained from the surface to 0.5 feet bgs and from the interval with the highest photoionization detector (PID) reading. In the event of no PID readings, a soil sample from the groundwater interface or at a depth of five feet will be obtained. Discrete surface and subsurface samples will be obtained from two sample locations and will be analyzed in a fixed laboratory for Phase I COPCs as shown in Table 3.

3.3 On-Site Random Grid Locations AOC-4

The sampling objectives for AOC-4 on-site soil sampling include determining the nature and extent of COPCs and collecting sufficient data of appropriate quality to assess site risks to either human or ecological populations.

Similar to AOC-2, composite sampling was performed at AOC-4. Sampling results indicated several COPCs detected above screening criteria. For Phase II, five random start grid sampling locations (Figure 5) have been selected at AOC-4 (G2-29S – G2-33S). The basis of decision for the proposed number of additional soil samples within AOC-4 is summarized in Table 2. Samples will be obtained from the surface to 0.5 feet bgs and from the interval with the highest photoionization detector (PID) reading. In the event of no PID readings, a soil sample from the groundwater interface or at a depth of five feet will be obtained. Discrete surface and subsurface samples will be obtained from five sample locations and will be analyzed in a fixed laboratory for Phase I COPCs as shown in Table 3.

3.4 On-Site Groundwater Locations

The objectives of the on-site groundwater investigation are to determine whether site activities have impacted the shallow aquifer or deeper aquifers and to characterize basic hydrogeology of the site. Groundwater sampling during the Phase II investigation will be accomplished with permanent monitor wells at seven locations.

Locations for the permanent monitor wells (Figure 2) were selected by VSP using a random start grid pattern, which includes two at the North site (MW01-01 – MW01-02) and five at the South site

(MW01-03 – MW01-07). The basis of decision for the proposed number of additional groundwater samples within AOC-1 is summarized in Table 2 with details presented as Appendix D, Table D-3. Groundwater samples will be analyzed in a fixed laboratory for Phase I COPCs as shown in Table 3. The groundwater data will be used to evaluate human health risk via the groundwater pathway and may be used to evaluate ecological risk through groundwater discharging to surface water. Monitor well installation, surveying and groundwater sampling will be conducted in accordance with the protocols discussed in Appendix A of the FSP.

3.5 Off-Site Random Grid Sediment Locations AOC-3

The sampling objectives for off-site sediment sampling include determining the nature and extent of contamination and collecting sufficient data of appropriate quality to assess site risks to either human or ecological populations.

The six random start grid sampling locations (G2-01SD - G2-06SD) were selected utilizing VSP (Figure 6). The basis of decision for the proposed number of additional sediment samples within AOC-3 is summarized in Table 2 with details presented as Appendix D, Table D-7. Analysis of Phase I results indicated no additional sediment sampling was necessary; however, six locations have been selected to confirm Phase I results and to again attempt to achieve MDLs lower than screening criteria.

Samples will be obtained from sediment, or soils if random wetland locations are not inundated, from the 0.0 to 0.5 foot interval and will be analyzed in a fixed laboratory for Phase I COPCs as shown in Table 3.

3.6 Off-Site Random Grid Locations AOC-5

The sampling objectives for off-site sediment sampling include determining the nature and extent of COPCs and collecting sufficient data of appropriate quality to assess site risks to either human or ecological populations.

Due to several detections above screening criteria, seven random start grid sampling locations (G2-07SD - G2-13SD) were selected utilizing VSP (Figure 7). These additional samples will be combined with the three results from Phase I sampling for a total of 10 samples to improve the strength of statistical analysis. The basis of decision for the proposed number of additional sediment samples within AOC-5 is presented in Table 2.

Samples will be obtained from the sediment from the 0.0 to 0.5 foot interval and will be analyzed in a fixed laboratory for Phase I COPCs as shown in Table 3.

3.7 Off-Site Surface Water Samples AOC-3

Surface water samples will be obtained from 16 locations within AOC-3 (G2-01SW - G2-16SW) and analyzed for metals, VOCs, SVOCs, PCBs and pesticides/herbicides. Specific sampling locations will be selected based on surface water conditions at the time of sampling. The basis of decision for the proposed number of additional surface water samples within AOC-3 is summarized in Table 2 with details presented as Appendix D, Table D-6.

The wetlands adjacent to the site are frequently dry and change configuration. Prior to sampling, the surface water area within AOC-3 will be mapped and VSP will be used to select 16 random start grid locations. The RPM will be notified of the selected sampling locations.

Surface water sampling for ecological assessment purposes will be in accordance with TCEQ's guidance document entitled (*Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Methods; RG-415*). The sampling protocol has been incorporated into TRC SOP No. 13.0, which is provided in Appendix E.

4.0 FIELD INVESTIGATION

This section describes the field investigation activities to be performed during Phase II of the RI at the site, including the rationale for the various field activities and the number of samples to be collected.

Samples will be analyzed by Accutest Laboratories using appropriate analytical methods for the isolation, detection, and quantification of specific target compounds and analytes. The applicable analytical methods (e.g., EPA SW-846 or equivalent) are referenced in the FSP and QAPP.

4.1 Utility Clearance and Site Reconnaissance

The initial site reconnaissance and characterization will be performed in accordance with TRC's standard operating procedure (SOP) No. 1.0. The site reconnaissance and characterization will include site and utilities identification, and a topographic survey, including easements, site surface features, and rights-of-way.

4.2 Geologic Investigation

The soil investigation includes an evaluation of surface and subsurface soils with regard to the nature and extent of COPCs. On-site random grid sample locations are shown on Figures 3, 4 and 5. Field sample locations are subject to field verification, and may be adjusted due to utilities, accessibility, etc.

All soil data determined to be usable for risk assessment will also be used in the HHRA and ERA. The on-site Phase II investigation includes the evaluation of soil and groundwater from the surface to the shallow aquifer, at a depth of approximately 12 feet bgs.

4.2.1 On-Site Surface Soil Sampling

Surface soils refer to those soils from the ground surface to 0.5 feet bgs. To characterize soil at all locations (including planned sample locations presently below concrete or asphalt), and to ensure samples may be used to characterize future on-site risks assuming present ground cover will change, underlying soil will be accessed through 6-inch-diameter core holes, where necessary, to access soils beneath concrete or asphalt.

Surface soil will be collected with either a (1) drive sampler device lined with acetate sleeves using Geoprobe equipment or (2) hand sampling device, such as a soil hand auger or manual drive sampler.

Soil samples for nature and extent of COPCs will be collected from depths determined in the field, based on lithologic characteristics and field-screening techniques. In some AOCs, nature and extent will be evaluated by both grid and judgmental boring locations.

4.2.2 On-Site Random Grid Surface Soil Samples

The surface soil sampling interval will be 0.0 to 0.5 foot bgs. Samples will be field-screened with a photoionization detector (PID).

On-site random grid surface soil samples will be obtained at AOC-1, AOC-2, and AOC-4, properly stored, and subsequently analyzed at a fixed laboratory.

4.2.3 On-Site Random Grid Subsurface Soil Sampling

Subsurface soils refer to those soils from depths greater than 0.5 feet bgs. Subsurface soil samples will be collected with a drive sampler lined with acetate sleeves using Geoprobe equipment.

Subsurface soil samples will undergo the same sample preparation procedures outlined for surface soil samples.

Lithologic core samples will be collected to evaluate surface and subsurface soil conditions as well as profile the unsaturated zone.

Samples will be field-screened with selected samples submitted to the fixed laboratory for analysis of COPCs as noted in Table 3.

4.3 On-Site Groundwater Sampling

During Phase II, seven locations will be selected for installation of permanent monitor wells within AOC-1. These wells will be installed immediately following soil sample collection, and properly developed.

Post-development groundwater samples collected from permanent monitoring wells will not be filtered when analyzed for VOCs and SVOCs. Groundwater collected for metals analysis will be split into filtered and unfiltered samples to permit identification of ratios of dissolved and suspended metal concentrations. Use of these ratios for site management or risk assessment purposes will be subject to prior review and approval of EPA. Groundwater will be analyzed for COPCs as indicated in Table 3.

Depending on the preliminary COPCs present and the magnitude of concentrations detected in the shallowest aquifer, additional investigation to the next deeper aquifer (for vertical nature and extent) may or may not be indicated. Specifically, the detection of naturally occurring metals in the shallowest aquifer is to be expected. Therefore further assessment of the next deeper aquifer may not be indicated based on comparison to background concentrations and the presence of significant concentrations relative to appropriate screening levels (based on unit classification) are detected in permanent monitoring wells.

Further assessment of groundwater contaminants may require a second mobilization during Phase II. Installation of monitor wells to a deeper aquifer would also take place during a subsequent mobilization.

If the shallow aquifer is impacted by site-related COPCs, the underlying water-bearing zones (WBZs) may need evaluation to determine the nature and extent of COPCs if (1) hydrogeological connections are suspected and (2) the contaminant fate and transport characteristics indicate a potential for downward migration. The investigation and sampling needs for the deeper WBZs will be discussed with EPA after evaluation of the Phase II shallow aquifer data.

4.4 Off-Site Sampling

Off-site field activities will include the following:

- Obtaining access agreements;
- Sampling sediment in the wetlands and bay adjacent to the site;
- Sampling soil in residential areas; and
- Sampling at background locations.

Each off-site sampling activity is discussed in the following sections. The sampling intervals and analytical suites at each off-site sampling location are summarized in Table 3.

4.4.1 Background Sampling

The preliminary COPCs at the site are inorganic and organic contaminants, which may be both (1) naturally occurring in geologic formations and (2) anthropogenic (man-made) contaminants resulting from the site and from adjacent facilities.

Background sampling has three goals, including providing data for (1) comparison of COPCs in surficial soils; (2) establishing attribution, via establishing either the absence or low-level (naturally occurring) concentrations of indicator or signature inorganic constituents, which may have been released from the site; and (3) establishing site-specific background concentrations for application to both the off-site and on-site soil investigation.

To assist identification of background sampling locations with a minimum likelihood of impact from former operations at the site and from surrounding industry, the Corpus Christi Wind Rose from January 1984 through December 31, 1992 is provided as Figure 8. Review of the wind rose data indicate the predominant wind direction at the site is from the southeast. As a result, background sampling locations to the southwest and northeast of the site will be preferentially selected.

Provided as Figure 9, is a wetland distribution map from the National Wetland Inventory of the site. Review of the figure shows the wetlands immediately to the east of the refinery are depicted as palustrine, emergent, persistent, seasonally flooded and excavated. Due to the manmade influence on this habitat, background sampling will not include this habitat.

The adjoining wetlands are classified under two habitats: 1) as estuarine, intertidal, emergent, persistent and irregularly flooded and 2) estuarine, intertidal, unconsolidated shore and regularly flooded. Background wetland sediment sampling will be in these two habitats.

AOC-5, the intracoastal way Bay, is a different aquatic environment from the wetland areas adjoining the site. As such, background concentrations of COPCs may be different in the wetland sediments compared to the intracoastal sediments. Background sample data from the intracoastal will be evaluated separately from the wetland background sample data.

During Phase I, four background locations were selected for each media of concern. During Phase II, additional locations will be sampled (Figure 10).

To meet these goals, six surface soil, six subsurface soil, six groundwater, six sediment wetland, six sediment intercoastal and six surface water background samples, as noted in Table 3 and shown on Figure 10, will be collected from areas identified as unlikely to be impacted by site operations. The areas were selected based on similar soil, sediment, and surface water types to AOC soil, sediment, and surface water.

At each of the locations, a sample will be collected and analyzed for the preliminary COPCs noted in Table 3.

4.4.2 Off-Site Sediment and Surface Water Sampling

The RI will include an investigation of sediment and surface water in adjacent wetlands (AOC-3) and in the intracoastal waterway (AOC-5). Wetland sediment/soil sampling locations will be identified using random start grid locations identified using VSP. The basis of decision for the proposed number of additional surface water samples in AOC-3 and AOC-5 is presented in Table 2.

The sediment samples from the intracoastal waterway will be random start grid locations to determine if there are COPCs associated with the current and historic barge dock facilities and the culvert draining into the intracoastal waterway.

At each sampling point, a conscious effort will be made to sample surface water without disturbing sediment (and in sequence with surface water collected prior to sediment collection). The surface water samples will be collected using a coliwasa, long-handled dipper, or submerged sample jar. All surface water samples collected for VOC analysis will be placed in sample containers with zero headspace. No stratification of the dissolved phase surface water is expected, based on the preliminary class of COPCs and the depths of the ponds. Therefore sampling from the most accessible surface meets the DQOs for the vertical boundaries of the on-site surface waters.

For Phase II at least five surface water samples will be split into filtered and unfiltered samples and analyzed as appropriate. Data from analysis of these split samples will be evaluated to identify ratios of dissolved to unfiltered concentrations. Use of these ratios for site management or risk assessment purposes will be subject to prior review and approval of EPA.

Sediment samples will be collected from the top 0.5 feet using a hand core sampler driven with a slide hammer, long-handled dipper, or other suitable sampling device as site-specific conditions warrant.

Sediments will be analyzed for preliminary COPCs as outlined in Table 3.

5.0 SAMPLE DESIGNATIONS

Each sample obtained in the field will be designated with a unique alphanumeric designation according to the following sample classifications.

5.1 Grid Sample Designation

Geoprobe surface and subsurface soil samples will be collected at grid nodes in AOC-1, AOC-2 and AOC-4. Random sediment samples will be obtained from AOC-3 and AOC-5. The grid sample designation will include three fields separated by dashes. For example: G2-01S-4.0-4.5.

- The first field, “G2-01S” identifies the grid sample number within Phase II. The alpha character is the designation for grid sample (G). The following numerical characters are the distinct number for the random grid sample location. The following alpha characters indicate the sample is a soil sample (S). If the sample is a sediment sample the designation SD will be used.
- The second field, “4.0” represents the top of the sample interval measured in feet bgs.
- The third field, “4.5” represents the bottom of the sample interval measured in feet bgs.

5.2 Groundwater Sample Designation

Groundwater sample designations will include separate nomenclature for samples collected from temporary monitoring wells and permanent monitoring wells.

Permanent monitor well (MW) groundwater sample designations will include two fields separated by a dash. For example: MW01-05.

- The two alpha characters in the first field, “MW01” identify the sample as having been collected from a permanent monitoring well and “01” identifies the AOC.
- The second field, “05,” represents the numerical designation for the permanent monitor well number.

If necessary to sample deeper aquifers during Phase II operations, an additional field will be added to the sample designations to show which aquifer is being assessed.

5.3 Surface Water Sample Designation

Surface water samples will be collected from wetlands and the intracoastal waterway. The surface water sample designation will include two fields separated by a dash. For example: SW-

01. The two alpha characters in the first field, "SW" identify the sample as a surface water (SW) sample. The second field, "01" represents the numerical designation of the surface water sample.

5.4 Background Soil Sample Designation

Field background samples will be identified by "BG" followed by a sequential number. The background sample designation includes three fields separated by a dash. For example: BG-01S-0.0-0.5.

- The first field, "BG" identifies the sample as a background (BG) sample followed by "01" which represents the numerical designation of the sample. The following alpha characters indicate the sample is a soil sample (S). If the sample is a sediment sample the designation SD will be used.

- The second field, "0.0" represents the top of the sample interval measured in feet bgs.

- The third field, "0.5" represents the bottom of the sample interval measured in feet bgs.

5.5 Background Groundwater Sample Designation

Groundwater background samples will be collected from temporary monitor wells (TW). The background groundwater samples designation will include two fields separated by a dash. For example: TWBG-10.

- The alpha characters in the first field, "TWBG" identify the sample as having been collected from a temporary monitoring well and "BG" identifies the sample as a background sample.

- The second field, "10," represents the numerical designation for the temporary monitor well.

5.6 Background Surface Water Sample Designation

Background surface water samples will be collected from wetlands. The background surface water designation will include two fields separated by a dash. For example: BG-20SW. The alpha characters in the first field, "BG" identify the sample as a background sample. The numeric characters in the second field, "20" represent the numerical designation for the sample, followed by the alpha characters "SW", indicating the sample as a surface water sample.

5.7 Field Duplicate Sample Designation

Field duplicate samples will be identified by adding a "D" to the end of the sample designations described above. For example, TW01-05D or MW01-05D and J-03S-0.0-0.5D.

5.8 Matrix Spike/Matrix Spike Duplicate (MS/MSD) Sample Designation (for organic analyses)

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) organic samples will be identified by adding an “MSD**”** to the end of the sample designations described above, for example: MW01-05MSD and J-03S-0.0-0.5MSD.

5.9 Matrix Spike/Matrix Duplicate (MS/MD) Sample Designation (for inorganic analyses)

MS and Matrix Duplicate (MD) inorganic samples will be identified by adding an “MD**”** to the end of the sample designations described above. For example: MW01-05MD and J-03S-0.0-0.5MD.

5.10 Trip and Equipment Blank Sample Designation

Trip and equipment blank samples will be identified sequentially beginning with TB-1 and EB-1, respectively.

6.0 SAMPLING EQUIPMENT AND PROCEDURES

This section is described in detail in the approved FSP dated August 24, 2008.

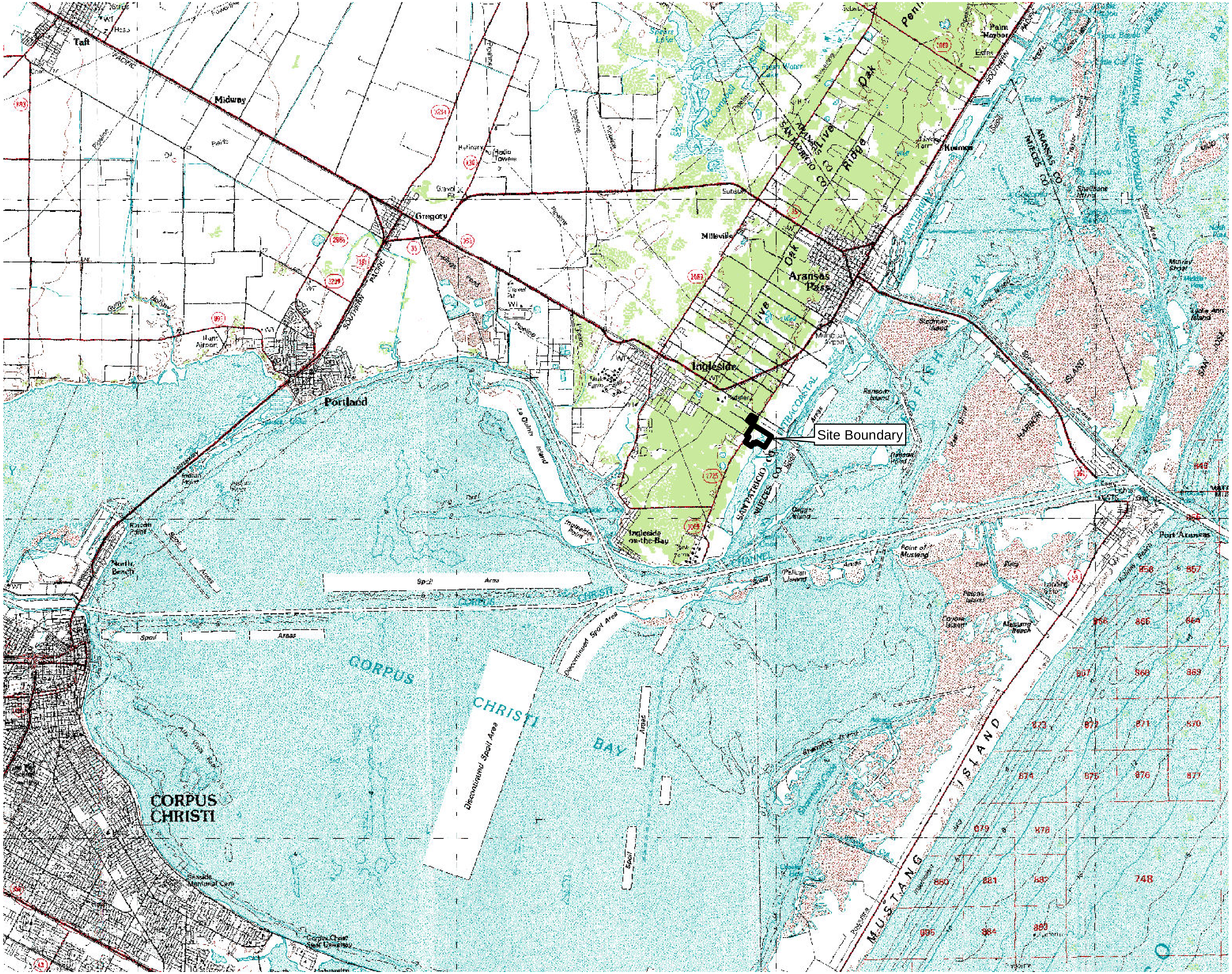
7.0 SCHEDULE

The following brief project schedule is planned:

- Phase II Field Investigations: April 2011 through June 2011
- Data Analysis: Phase II May 2011 through August 2011
- Draft Preliminary Site Characterization Summary Report: September 2011
- Draft Baseline Human Health Risk Assessment: February 2012
- Draft Screening Level Ecological Risk Assessment: February 2012
- Draft Remedial Investigation Report: February 2012
- Draft Feasibility Study Report: August 2012

A detailed schedule of all activities is available in the RI/FS Work Plan.

Figures



Legend

Site Boundary

Reference: U.S.G.S. 1:100,000-Scale Topographic Map, Driscoll, Texas (1980).

N

10,000 0 10,000

Feet

AREA MAP

FALCON REFINERY
INGLESIDE, SAN PATRICIO COUNTY, TEXAS

PROJECT NO.: 182978 | DATE: 3/10/2011

TRC

505 EAST HUNTLAND DRIVE
SUITE 250
AUSTIN, TEXAS 78752
512-329-6080

FIGURE
1

AREA OF CONCERN MAP

FALCON REFINERY
INGELSIDE, SAN PATRICIO COUNTY, TEXAS

PROJECT NO.: 182978 | DATE: 3/10/2011

TRC
505 EAST HUNTLAND DRIVE
SUITE 250
AUSTIN, TEXAS 78752
512-329-6080

FIGURE
2

Legend

- Proposed Soil Sample Location
- Proposed Monitor Well Location
- AOC 1 Boundary

Source: National Agriculture Imagery Program (NAIP), 2009.

N

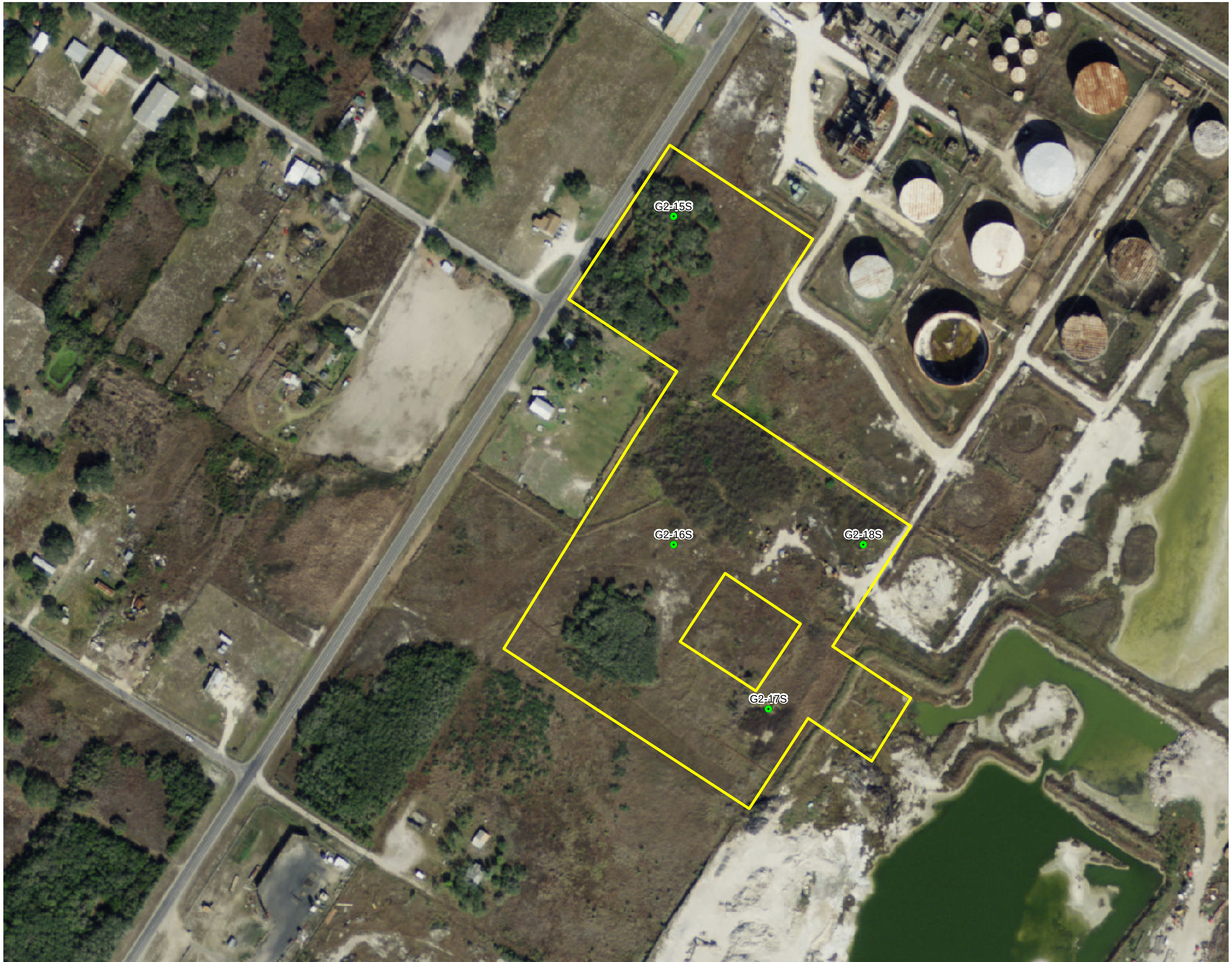
400 0 400

Feet

AOC 1
PROPOSED SAMPLE LOCATIONS

FALCON REFINERY
INGELSIDE, SAN PATRICIO COUNTY, TEXAS

PROJECT NO.: 182978	DATE: 3/10/2011	
TRC	505 EAST HUNTLAND DRIVE SUITE 250 AUSTIN, TEXAS 78752 512-329-6080	FIGURE 3



Legend

- Proposed Soil Sample Location
- AOC 2 Boundary

Source: National Agriculture Imagery Program (NAIP), 2009.

N

400 0 400
Feet

AOC 2
PROPOSED SAMPLE LOCATIONS

FALCON REFINERY
INGELSIDE, SAN PATRICIO COUNTY, TEXAS

PROJECT NO.: 182978 | DATE: 3/10/2011

TRC
505 EAST HUNTLAND DRIVE
SUITE 250
AUSTIN, TEXAS 78752
512-329-6080

FIGURE 4

Legend

- Proposed Soil Sample Location
- AOC 4 Boundary

Source: National Agriculture Imagery Program (NAIP), 2009.

N

200 0 200

Feet

AOC 4
PROPOSED SAMPLE LOCATIONS

FALCON REFINERY
INGELSIDE, SAN PATRICIO COUNTY, TEXAS

PROJECT NO.: 182978 | DATE: 3/10/2011

TRC

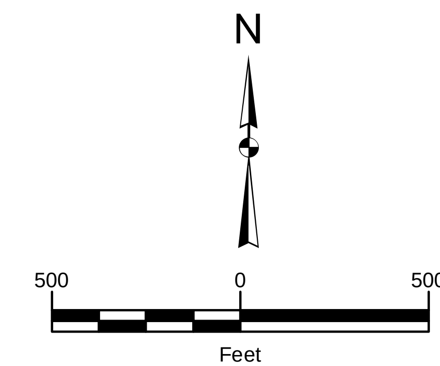
505 EAST HUNTLAND DRIVE
SUITE 250
AUSTIN, TEXAS 78752
512-329-6080

FIGURE
5

Legend

- Proposed Sediment Sample Location
- AOC 3 Boundary

Source: National Agriculture Imagery Program (NAIP), 2009.



AOC 3
PROPOSED SAMPLE LOCATIONS

FALCON REFINERY
INGELSIDE, SAN PATRICIO COUNTY, TEXAS

PROJECT NO.: 182978	DATE: 3/10/2011	
TRC	505 EAST HUNTLAND DRIVE SUITE 250 AUSTIN, TEXAS 78752 512-329-6080	FIGURE 6

Legend

- Proposed Sediment Sample Location
- AOC 5 Boundary

Source: National Agriculture Imagery Program (NAIP), 2009.

N

500 0 500

Feet

AOC 5
PROPOSED SAMPLE LOCATIONS

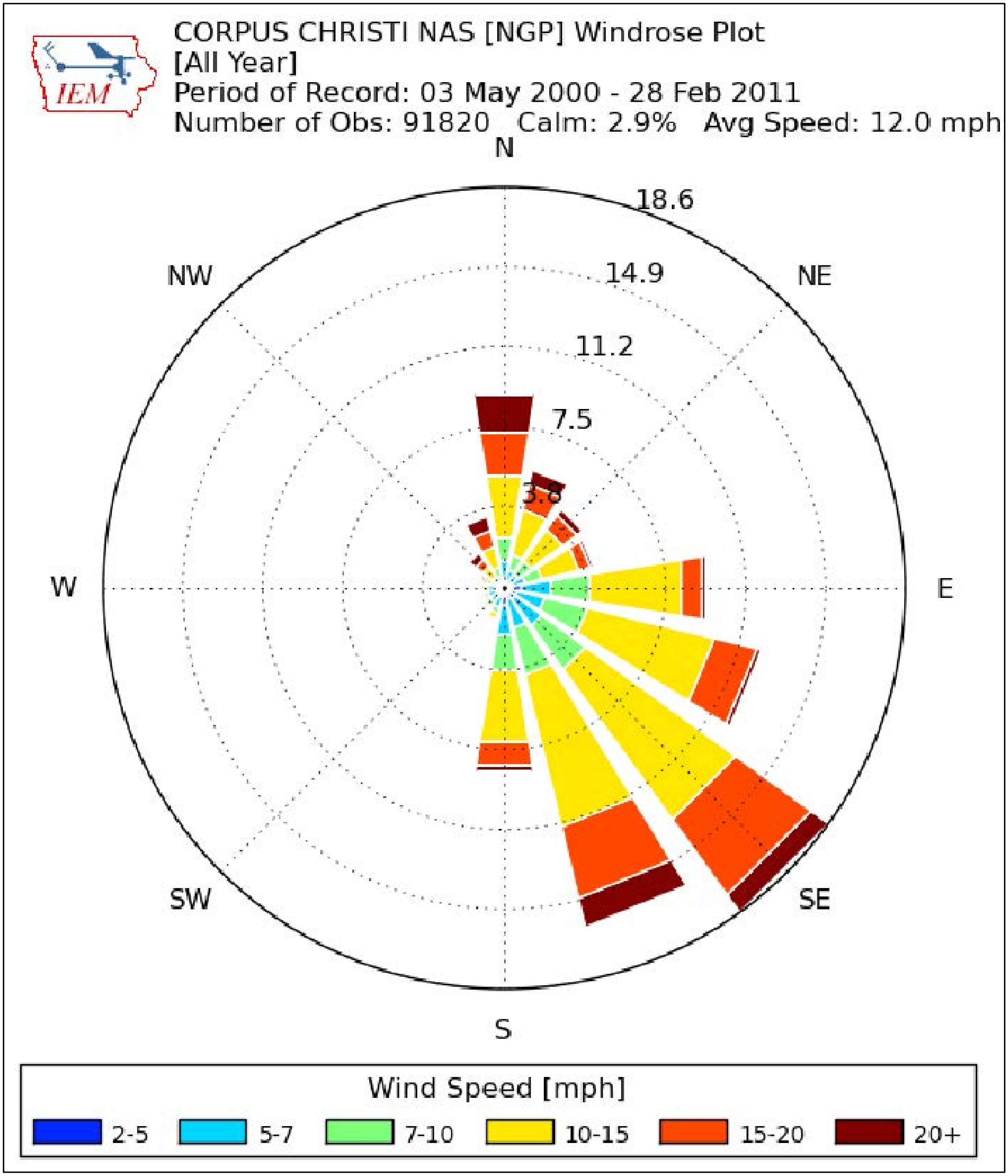
FALCON REFINERY
INGELSIDE, SAN PATRICIO COUNTY, TEXAS

PROJECT NO.: 182978 | DATE: 3/10/2011

TRC

505 EAST HUNTLAND DRIVE
SUITE 250
AUSTIN, TEXAS 78752
512-329-6080

FIGURE 7



CORPUS CHRISTI WIND ROSE

FALCON REFINERY
INGLESIDE, SAN PATRICIO COUNTY, TEXAS

PROJECT NO.	182978	DWG FILE	182978–8
DRAWN BY.	CL	DATE	3/10/11

TRC
505 EAST HUNTLAND DRIVE
SUITE 250
AUSTIN, TEXAS 78752
(512) 329–6080

FIGURE
8

NOTES:
1. SOURCE: IOWA ENVIRONMENTAL MESONET, IOWA STATE UNIVERSITY DEPARTMENT OF AGRONOMY.

Legend

AOC Boundary

Wetland

Reference: Geologic Atlas of Texas, Laredo Sheet (1976).

N

500 0 500

Feet

NATIONAL WETLAND INVENTORY

FALCON REFINERY
INGELSIDE, SAN PATRICIO COUNTY, TEXAS

PROJECT NO.: 182978	DATE: 3/10/2011

TRC

505 EAST HUNTLAND DRIVE
SUITE 250
AUSTIN, TEXAS 78752
512-329-6080

FIGURE
9

Legend

- Proposed Soil Sample Location
- Proposed Sediment Sample Location
- Proposed Surface Water Sample Location
- Proposed Groundwater Sample Location

Source: National Agriculture Imagery Program (NAIP), 2009.

N

1,000 0 1,000

Feet

BACKGROUND SAMPLING LOCATION MAP

FALCON REFINERY
INGELSIDE, SAN PATRICIO COUNTY, TEXAS

PROJECT NO.: 182978	DATE: 3/10/2011	
TRC	505 EAST HUNTLAND DRIVE SUITE 250 AUSTIN, TEXAS 78752 512-329-6080	FIGURE 10

Tables

TABLE 1
AREAS OF CONCERN
FALCON REFINERY SUPERFUND SITE
INGLESIDE, TEXAS

AOC	LOCATION		SURFACE WATER SAMPLE NUMBER	SAMPLE LOCATION NUMBER	MONITOR WELL/GROUNDWATER LOCATONS	COPCs
1N	North section of the Refinery complex, on the northeast side of the FM 2725/Bishop Rd. intersection.	Surface Soil Subsurface Soil Groundwater		G2-01S - G2-04S	MW01-01 - MW01-02	Metals VOCs SVOCs PCBs Pesticides
1S	South section of the Refinery complex, on the southwest side of the FM 2725/Bishop Rd. intersection.	Surface Soil Subsurface Soil Groundwater		G2-05S - G2-24S	MW-03 - MW-07	Metals VOCs SVOCs PCBs Pesticides
2	On-site non-process areas, west of the south section of the Refinery complex.	Surface Soil Subsurface Soil		G2-25S - G2-28S		Metals VOCs SVOCs PCBs Pesticides
3	Wetlands	Surface Soil Subsurface Soil Sediment Surface Water	G2-01SW - G2-16SW	G2-01SD - G2-06SD		Metals VOCs SVOCs PCBs Pesticides
4	Current barge docking site	Surface Soil Subsurface Soil		G2-29S - G2-33S		Metals VOCs SVOCs PCBs Pesticides
5	Redfish Bay adjacent to current barge docking facility	Sediment Surface Water		G2-07SD - G2-13SD		Metals VOCs SVOCs PCBs Pesticides
6	Neighborhood **					
7	Neighborhood **					
BG	To be determined	Surface Soil Subsurface Soil Groundwater Sediment Surface Water	BG-15SW - BG20-SW	BG-09S - BG-14S BG-15SDW - BG-20SDW BG-21SDI - BG-26SDI	TWBG-09 - TWBG-14	Metals VOCs SVOCs

* Due to flucuations in surface water locations within wetlands, exact locations are not listed.
** May require sampling after Phase II addendum No. 1

AOC	Area of Concern
COPC	Contaminant of Potential Concern
VOC	Volatile Organic Compound
GW	groundwater
BKG	Background
SVOC	Semi-volatile Organic Compound
SD	Sediment
SW	Surface water

TABLE 2
SUMMARY OF CALCULATED MINIMUM SAMPLE QUANTITIES
FALCON REFINERY
INGLESIDE, TEXAS

AOC	Media	Quantity of Discrete Phase I Samples	Additional Sample Number Basis			Proposed Quantity of Additional Samples
			Human Health	Ecological	Best Professional Judgment	
AOC 1	Soil: Surface & Subsurface	41	14	None	Not Applicable	14
	Sediment	2	Not Applicable	Not Applicable	None	None
	Groundwater	20	7	Not Applicable	Not Applicable	7
AOC 2	Soil: Surface & Subsurface	Composite Samples	Not Applicable	Not Applicable	4	4
AOC 3	Soil: Surface & Subsurface	7	1	14	None	None
	Sediment	44	None	None	6	6
	Surface Water	7	16	5	Not Applicable	16
AOC 4	Soil: Surface & Subsurface	Composite Samples	Not Applicable	Not Applicable	5	5
AOC 5	Sediment	3	Not Applicable	Not Applicable	7	7
AOC 6	Soil: Surface & Subsurface	3	Not Applicable	Not Applicable	None	None
AOC 7	Soil: Surface & Subsurface	2	Not Applicable	Not Applicable	None	None

TABLE 3
SAMPLING AND DESIGN MATRIX
FALCON REFINERY SUPERFUND SITE
INGLESIDE, TEXAS

SAMPLING TYPE	AREA OF CONCERN NUMBER	INTERVAL (feet bgs)	ANALYSES				
			TCL VOC	**TCL SVOC**	**TAL METALS**	**PCBs**	**Herbicides and Pesticides**
ON-SITE RANDOM GRID SURFACE AND SUBSURFACE SOIL SAMPLES							
Geoprobe	1N	0 to 0.5	4	4	4	1	1
		0.5 to 5.0	4	4	4	1	1
	1S	0 to 0.5	20	20	20	2	2
		0.5 to 5.0	20	20	20	2	2
TOTAL FOR ON-SITE AOC-1 RANDOM GRID SAMPLES			**48**	**48**	**48**	**6**	**6**
QC FOR RANDOM GRID SAMPLES							
QC MS/MSD* {1/20 organics}		Various	3	3	N/A	N/A	1
QC MS/MD* {1/20 organics}		Various	N/A	N/A	N/A	1	N/A
QC trip blank		1	N/A	N/A	N/A	N/A	N/A
QC field duplicate {1/10}		Various	5	5	5	1	1
QC EQUIPMENT RINSATE		N/A	2	2	2	1	1
TOTALGRID QC SAMPLES			**10**	**10**	**7**	**3**	**0**
Geoprobe	2	0 to 0.5	4	4	4	1	1
		0.5 to 5.0	4	4	4	1	1
	4	0 to 0.5	5	5	5	1	1
		0.5 to 5.0	5	5	5	1	1
TOTAL FOR ON-SITE AOC-2 and AOC-4 RANDOM GRID SAMPLES			**18**	**18**	**18**	**4**	**4**
QC FOR GRID SOIL SAMPLES							
QC MS/MSD* {1/20 organics}		Various	1	1	N/A	N/A	1
QC MS/MD* {1/20 organics}		Various	1	1	N/A	N/A	N/A
QC trip blank		1	1	1	N/A	1	N/A
QC field duplicate {1/10}		Various	2	2	2	1	1
QC equipment rinsate		N/A	1	1	1	1	1
TOTAL GRID QC SAMPLES			**6**	**6**	**3**	**3**	**3**

TABLE 3
SAMPLING AND DESIGN MATRIX
FALCON REFINERY SUPERFUND SITE
INGLESIDE, TEXAS

SAMPLING TYPE	AREA OF CONCERN NUMBER	INTERVAL (feet bgs)	ANALYSES				
			TCL VOC	TCL SVOC	TAL METALS	PCBs	Herbicides and Pesticides
OFF-SITE JUDGMENTAL SURFACE AND SUBSURFACE SAMPLES							
Geoprobe	3	0 to 0.5	0	0	0	0	0
		0.5 to 5.0	0	0	0	0	0
	5	0 to 0.5	0	0	0	0	0
	6	0 to 0.5	0	0	0	0	0
		0.5 to 5.0	0	0	0	0	0
	7	0 to 0.5	0	0	0	0	0
		0.5 to 5.0	0	0	0	0	0
TOTAL FOR ON-SITE JUDGMENTAL SAMPLES			**0**	**0**	**0**	**0**	**0**

QC FOR OFF-SITE JUDGMENTAL SAMPLES						
QC MS/MSD* {1/20 organics}	Various	0	0	N/A	N/A	0
QC MS/MD* {1/20 organics}	Various	N/A	N/A	N/A	0	N/A
QC trip blank {1/cooler for aqueous VOCs}	N/A	N/A	N/A	N/A	N/A	N/A
QC field duplicate {1/10}	Various	0	0	0	0	0
QC EQUIPMENT RINSATE	N/A	0	0	0	0	0
TOTAL JUDGMENTAL QC SAMPLES		**0**	**0**	**0**	**0**	**0**

OFF-SITE RANDOM GRID SEDIMENT SAMPLES							
Grab	3	0-0.5	6	6	6	1	1
	5	0-0.5	7	7	7	1	1
TOTAL FOR GRID SAMPLES			**6**	**6**	**6**	**1**	**1**

QC FOR GRID SOIL SAMPLES						
QC MS/MSD* {1/20 organics}	Various	1	1	N/A	N/A	1
QC MS/MD* {1/20 organics}	Various	N/A	N/A	N/A	N/A	N/A
QC trip blank {1/cooler for aqueous VOCs}	N/A	N/A	N/A	N/A	N/A	N/A
QC field duplicate {1/10}	Various	1	1	1	1	1
QC equipment rinsate	N/A	1	1	1	1	1
TOTAL GRID QC SAMPLES		**3**	**3**	**2**	**2**	**0**

TABLE 3
SAMPLING AND DESIGN MATRIX
FALCON REFINERY SUPERFUND SITE
INGLESIDE, TEXAS

SAMPLING TYPE	AREA OF CONCERN NUMBER	INTERVAL (feet bgs)	ANALYSES				
			TCL VOC	TCL SVOC	TAL METALS	PCBs	Herbicides and Pesticides
GROUNDWATER SAMPLING (7 Monitor Wells)							
Bailer	1N	Shallow aquifer	2	2	2	1	1
	1S	Shallow aquifer	5	5	5	1	1
TOTAL FOR MONITOR WELL SAMPLES			**7**	**7**	**7**	**2**	**2**

QC FOR AQUEOUS SAMPLES (MONITOR WELLS)						
QC MS/MSD* {1/20 organics}	Various	1	1	N/A	N/A	1
QC MS/MD* {1/20 organics}	Various	N/A	N/A	N/A	0	N/A
QC trip blank {1/cooler for aqueous VOCs}	N/A	2	1	N/A	N/A	N/A
QC field duplicate {1/10}	Various	1	1	1	1	1
QC Equipment Rinsate	Various	1	1	1	1	1
TOTAL MONITOR WELL QC SAMPLES		**5**	**4**	**2**	**2**	**3**

SURFACE WATER SAMPLING							
Grab	3	Surface	16	16	16	2	2
TOTAL FOR SURFACE WATER SAMPLES			**16**	**16**	**16**	**2**	**2**

QC FOR AQUEOUS SAMPLES (SURFACE WATER)						
QC MS/MSD* {1/20 organics}	Various	1	1	N/A	N/A	1
QC MS/MD* {1/20 organics}	Various	N/A	N/A	N/A	0	N/A
QC trip blank {1/cooler for aqueous VOCs}	N/A	2	2	N/A	N/A	N/A
QC field duplicate {1/10}	Various	2	2	1	1	1
QC Equipment Rinsate	Various	1	1	1	1	1
TOTAL QC SAMPLES		**6**	**6**	**2**	**2**	**3**

TABLE 3
SAMPLING AND DESIGN MATRIX
FALCON REFINERY SUPERFUND SITE
INGLESIDE, TEXAS

SAMPLING TYPE	AREA OF CONCERN NUMBER	INTERVAL (feet bgs)	ANALYSES: TCL VOC	TCL SVOC	TAL METALS	PCBs	Herbicides and Pesticides
BACKGROUND SAMPLES (JUDGMENTAL)							
Grab	Sediment	0-0.5	12	12	12	0	0
Geoprobe	Surface Soil	0-0.5	6	6	6	0	0
	Subsurface Soil	0.5-5.0	6	6	6	0	0
		TOTAL FOR JUDGMENTAL SAMPLES	**24**	**24**	**24**	**0**	**0**

BACKGROUND GROUNDWATER SAMPLING (6 Temporary Wells)							
Bailer	Groundwater	Shallow aquifer	6	6	6	0	0
		TOTAL FOR JUDGMENTAL SAMPLES	**6**	**6**	**6**	**0**	**0**

BACKGROUND SURFACE WATER SAMPLING							
Grab	Surface Water	Surface	12	12	12	0	0
		TOTAL FOR GRID and BACKGROUND SW SAMPLES	**12**	**12**	**12**	**0**	**0**

QC FOR ALL BACKGROUND SAMPLING						
QC MS/MSD* {1/20 organics}	Various	2	2	N/A	N/A	0
QC MS/MD* {1/20 organics}	Various	N/A	N/A	N/A	0	N/A
QC trip blank {1/cooler for aqueous VOCs}	N/A	2	2	N/A	N/A	N/A
QC field duplicate {1/10}	Various	4	4	4	0	0
QC Equipment Rinsate	Various	1	1	1	0	0
	TOTAL QC SAMPLES	**9**	**9**	**5**	**0**	**0**

TABLE 3
SAMPLING AND DESIGN MATRIX
FALCON REFINERY SUPERFUND SITE
INGLESIDE, TEXAS

SAMPLING TYPE	AREA OF CONCERN NUMBER	INTERVAL (feet bgs)	ANALYSES				
			TCL VOC	**TCL SVOC**	**TAL METALS**	**PCBs**	**Herbicides and Pesticides**
INVESTIGATION-DERIVED WASTE							
Hand sampling device	Site-wide	Drummed Waste	TO BE DETERMINED				

QC FOR INVESTIGATION-DERIVED WASTE						
QC MS/MSD* {1/20 organics}	Various	0	0	N/A	N/A	0
QC MS/MD* {1/20 organics}	Various	N/A	N/A	N/A	0	N/A
QC trip blank {1/cooler for aqueous VOCs}	N/A	0	N/A	N/A	N/A	N/A
QC field duplicate {1/10}	Various	0	0	0	0	0
QC Equipment Rinsate	Various	0	0	0	0	0
	TOTAL QC SAMPLES	**0**	**0**	**0**	**0**	**0**

* MS/MSD and MS/MDs: These samples do not increase the number of samples, but represent additional volume of sample for laboratory QA/QC.

AOC	Area of Concern	N/A	Not Applicable
bgs	Below Ground Surface	PCB	Polychlorinated Byphenyls
MD	Matrix Duplicate	QC	Quality Control
MS	Matrix Spike	SVOC	Semivolatile Organi
MSD	Matrix Spike Duplicate	VOC	Volatile Organic Compound

Appendix E: Standard Operating Procedures (SOP)

Title: **Utility Clearance & Site Reconnaissance**	*Procedure Number:* **No. 1.0**
Project: **Falcon Refinery Superfund Site, Ingleside, TX**	*Revision Number:* **0.0**
Reason for Revision: **NA**	*Revision Date:* **March 2011**

1-1.0 PURPOSE, SCOPE, AND APPLICABILITY

This Standard Operating Procedure (SOP) was prepared to inform TRC personnel of the utility clearance and site reconnaissance that must be conducted before any intrusive investigations may be conducted on a site. Intrusive activities such as intrusive investigation or excavation have the potential to damage underground or overhead utilities. Therefore, a utility clearance, or the location of utilities by an appropriate public agency or private entity, is strictly required before any intrusive activities may be conducted. These activities include, but are not limited to, drilling, augering, excavating, trenching, and remedial construction. The goal of these procedures is to confirm that the proposed intrusive work activities can be conducted without unintentional damage to, or unexpected complications arising from the presence of, the utilities.

1-2.0 PROCEDURES

- All utility lines (above and below ground) should be identified using reasonable and responsible measures for the purpose of avoiding impacts to utility lines during intrusive investigations (i.e. drilling, hand augering, etc.) and excavation operations.

- Drilling locations shall be no closer than 25 feet to overhead utilities. The appropriate utility companies will be contacted to provide insulation of utility lines prior to commencement of drilling activities.

- Locations of planned intrusive activities should be marked at least 14 days prior to commencing work. Acceptable markers include white spray paint, or a utility stake painted white (or with white flagging), in accordance with the generally accepted American Public Works Association (APWA) universal color code for facilities identification:

  - RED – Electric Power Lines, Cables, Conduit, and Lighting Cables
  - YELLOW – Gas, Oil, Steam, Petroleum, or Gaseous Material
  - ORANGE – Communication, Alarm or Signal Lines, Cables, or Conduit
  - BLUE – Potable Water
  - GREEN – Sewers and Drain Lines
  - WHITE – Proposed Excavation Limits or Route
  - PINK – Temporary Survey Markings, Unknown / Unidentified Facilities
  - PURPLE – Reclaimed Water, Irrigation, and Slurry Lines

- A public notification agency such as OneCall, JULIE, or DigTESS must be contacted for utility clearance at least 48 hours, but no more than 14 days, prior to commencing drilling or excavating activities.

- In cases of activities conducted on private property, it is necessary to contact the landowner in addition to a public notification agency.

- In some cases it may be necessary to meet with utility personnel on site prior to commencing intrusive activities. This will minimize the potential for miscommunication and errors.

- The Engineer/Technical Expert shall verify the existence of all suspected utilities not otherwise identified by the Notification Center (utilities located on private property and those not subscribed to the service). At a minimum, the following types of utilities shall be investigated: electrical cables, oil and gas pipelines, water pipelines, communication lines, fiber optic lines, and sanitary sewers. For signal control cables, traffic cameras cables, etc., contact the state or district's transportation department Traffic Operations office.

- Utility location notification is not a guarantee that no man-made objects will be encountered during intrusive work activities, and therefore should be conducted with extreme caution. If uncertainty exists, alternative precautionary measures should be implemented, which may include hand digging, hand augering, or probing.

1-3.0 SAFETY CONSIDERATIONS

Failure to follow the procedure outlined in this document could result in personal injury and property damage. For this reason, it is imperative that these procedures be followed and that any additional reasonable and responsible measures are taken to minimize risk.

1-4.0 EQUIPMENT AND SUPPLIES

- White spray paint
- Stakes (Painted white, or with white flags)
- Utility representative contact information
- Available drawings & maps

1-5.0 CONTACTS

- Texas811: (800) DIG-TESS; https://www.digtess.org

1-6.0 TRAINING AND/OR QUALIFICATIONS

All persons performing the activities described in this SOP must have read and have an understanding of the contents. The individual must previously be instructed in the safe handling of chemicals. An understanding of project-specific plans (e.g., Field Sampling Plan, Quality Assurance Project Plan, etc.) and requirements is also recommended.

STANDARD OPERATING PROCEDURE

Title: **Field Operation Records & Documentation**	*Procedure Number:* **No. 2.0**
Project: **Falcon Refinery Superfund Site, Ingleside, TX**	*Revision Number:* **0.0**
Reason for Revision: **NA**	*Revision Date:* **March 2011**

2-1.0 PURPOSE, SCOPE, & APPLICABILITY

This Standard Operating Procedure (SOP) has been prepared to inform TRC personnel of the field logbook documentation requirements for field investigations. Recorded field data becomes a legal record of project work and appropriate recording of field data is imperative.

Proper documentation is an important part of the field investigation program. The logbook is a written record of the daily sampling and other events occurring at the site during the site investigation. The logbook entries should describe in chronological order all pertinent activities and events that are related to the project or that could potentially affect the project. Entries should be legible and complete so that they can be read and understood by all readers and misinterpretation of data entries is avoided.

2-2.0 PROCEDURES

2-2.1 *CONTENT*

Keep a chronological log of the day's activities, including: times of arrival and departures, phone calls (received and placed), changes in weather, and/or changes in work plan. Note each incident separately, noting time using the 0000-2400 hour system to prevent error. Include all technical information from the field, including any forms, log sheets, printouts, and business cards. Tape the information to the logbook in order to keep all information together. Use hand drawn maps to indicate sampling points or other significant features. Avoid drawing conclusions from collected data; record only objective, empirical measurements. Avoid making personal comments that do not pertain to the site activity objectives.

The following information must be entered for each logbook used during a site investigation:

1. Site name, location, and project number.
2. Sampling event date and time (0000-2400 method).
3. Weather conditions.
4. Sampling equipment used. The make and model of any equipment used to collect groundwater samples and used to collect other field data such as water quality parameters and water levels must be recorded in the logbook.
5. Equipment calibration information. Calibration procedures and results must be documented as they are performed and obtained. Sources of calibration standards and equipment identification numbers will be documented.
6. Sample location and identification number.
7. Sampler's name.
8. Sampling method used.
9. Description of sample collected, including matrix, QC samples, number of sampling containers filled, preservative, visual and olfactory description of sample, and any other pertinent information.

10. Field parameter data (including pH, temperature, dissolved oxygen, specific conductance, oxidation-reduction potential, water level, and flow rate). Record parameter units.
11. Analysis requested.
12. Other Pertinent Information.

2-2.2 *LAYOUT/FORMAT*

While recording in the field logbook, the following information should be considered:

- Document everything, in pen, do not rely on memory;
- Print clearly;
- Date each page of the logbook, starting a new day on a new page;
- Lay out data tables, including labeled columns and rows, when collecting series of data. Try to set up the table ahead of time for neatness and legibility;
- Recopy information that is unclear onto another page, indicating the corresponding page and date of the entry. Cross out original information to prevent confusion;
- Clearly strikethrough mistakes with a single line; initial and date corrections;
- Keep an up to date table of contents in the front of the logbook for quick reference;
- Note all correspondence in logbook, including date, time, and persons involved in correspondence;
- If several logbooks are use, develop a system to keep them in chronological order, noting any information that may extend to a new logbook.

2-3.0 TRAINING AND/OR QUALIFICATIONS

All persons performing the activities described in this SOP must have read and have an understanding of the contents. The individual must previously be instructed in the safe handling of chemicals. An understanding of project-specific plans (e.g., Field Sampling Plan, Quality Assurance Project Plan, etc.) and requirements is also recommended.

STANDARD OPERATING PROCEDURE

Title: Chain-of-Custody and Labeling	Procedure Number: No. 3.0
Project: Falcon Refinery Superfund Site, Ingleside, TX	Revision Number: 0.0
Reason for Revision: NA	Revision Date: March 2004

3-1.0 PURPOSE, SCOPE, & APPLICABILITY

This Standard Operating Procedure (SOP) was prepared to direct TRC personnel in the documentation requirements for collecting samples. The SOP is consistent with EPA guidelines and other pertinent technical publications and environmental industry standards.

Sample handling is an important part of the field investigation program since samples that are incorrectly handled can affect the quality of data. A stringent chain-of-custody system is vitally important in ensuring the usefulness of measurement data as this provides the "objective evidence" that appropriate sample handling procedures were followed. Sample handling begins at the collection of the samples and continues until final disposition of the sample. Described in this section are sample custody and documentation, including sample labeling and protocols.

3-2.0 PROCEDURES

An overriding consideration essential for the validation of environmental measurement data is the necessity to demonstrate that samples have been obtained from the locations stated and that they have reached the laboratory without alteration. Sample custody is an organized scheme for documenting sampling history and providing a legal record of the measurement process. Evidence of the sample traceability from collection to shipment, laboratory receipt, and laboratory custody (until proper sample disposal and the introduction of field investigation results as evidence in legal proceedings when pertinent) must be documented. The types of sample custody documentation include:

- Field data sheets and/or field notes (dated and initialed);
- Sample logbooks;
- Sample labels;
- Chain-of-custody records;
- Dated instrument output (e.g., strip chart records, chromatograms);
- Laboratory data sheets and/or logbooks; and
- Records of deviations from and/or modifications to any measurement protocol.

A sample is considered to be in a person's custody if the sample is:

- In a person's actual possession;
- In view after being in a person's possession;
- Locked so that no one can tamper with it after having been in physical custody; or
- In a secured area, restricted to authorized personnel.

The designated sample custodian is responsible for overseeing and supervising the implementation of proper sample custody procedures in the field. The sample custodian is also responsible for ensuring sample custody until the samples have been transferred to a courier or directly to the laboratory. Once received by the laboratory, the samples proceed through an orderly processing sequence specifically designed to ensure continuous integrity of both the sample and its documentation. By following these procedures, the needed documented traceable link between the reported measurement results and the sample and parameter that it is reported to represent will be generated.

3-2.1 ***CHAIN-OF-CUSTODY***

Chain-of-custody procedures should originate with the preparation of any sample containers (e.g., preparation of pre-preserved containers) and should indicate the identities of the individual custodians and their actions until final disposition of the sample. The custody procedures used should ensure that the integrity of the sample is maintained throughout the course of the collection, handling, and analysis process, ensuring that there is no opportunity for inadvertent contamination. Without acceptable, documented chain-of-custody, the data are subject to question.

The chain-of-custody procedures consist of:

- Preparing a data sheet documenting procedures and chemicals used to prepare sample containers;
- Preparing and attaching a unique sample label to each sample collected;
- Documenting pertinent site, sample collection, and field measurement information into a field logbook or data sheet;
- Completing the chain-of-custody form;
- Preparing and packing the samples for shipment;
- Documenting laboratory receipt or the samples;
- Documenting laboratory storage, handling, and analysis; and
- Documenting final disposition of the sample.

3-2.2 ***SAMPLE LABELS***

Field personnel are responsible for uniquely identifying and labeling all samples collected during a field investigation program at the time of sampling to avoid accidental mislabeling. The sample identifications should be double checked with the sample location. All labeling must be completed in indelible/waterproof ink and securely affixed to the sample container. Tape is not to be used to protect the sample label. Each sample label will include:

1. Project Name.

2. Sample Location/Description Number - Monitoring wells have been assigned a unique location number.

3. Unique Sample Identification Number - Sample identification must be consistent.

4. Sample Matrix - The label must indicate the sample matrix (e.g. groundwater or soil).

5. Analysis Requested - The analytical method required for a particular sample must be indicated on the sample label.

6. Preservative – Required sample preservation methods (e.g. pH<2 HCl) must be indicated on the sample label.

7. Date and time of sample collection

8. Sampler's Initials - The initials of the person who collected the sample must be written on the sample label.

Sample labels will be waterproof with a strong adhesive backing.

3-2.3 ***CUSTODY SEAL***

Custody seals will be secured across the shipping container to ensure content integrity. The seals contain both the date of shipment and the signature of the person affixing them and must be completed in indelible/waterproof ink.

3-2.4 ***CHAIN-OF-CUSTODY RECORD***

Chain-of-custody (COC) forms must be completed for each sample set submitted for analysis. These forms are maintained as a record of sample collection, transfer, shipment, and receipt by the laboratory. These forms also contain pertinent information concerning sampling locations, collection dates, signatures of at least one sampling team member, sample matrices, assigned sample identification numbers, the project name and number, and the name of the laboratory to which the samples are being sent for analysis. The name, phone number, and fax number of the Project Manager should be noted on the COC form. Samples suspected of being heavily contaminated should be noted. COC forms must be completed to ensure proper transfer of custody from the time of sample collection to analysis. A copy of each completed COC form is either maintained in the field office or forwarded to the Task or Project Manager.

3-2.5 ***TRANSFER OF CUSTODY***

A completed COC form will accompany samples during each step of custody transfer and shipment. When physical possession of samples is transferred, both the individual relinquishing the samples and the individual receiving them will sign, date, and record the time on the COC form. In the case of sample shipment by an overnight courier, a properly prepared air bill will serve as an extension of the COC form while the samples are in transit.

Samples will be packaged and shipped in accordance with TRC SOP No. 4.0

3-3.0 QUALITY CONTROL PROCEDURES

Accurate completion of labels and forms will be verified prior to transfer of sample custody. The Field Team Leader will be ultimately responsible for confirming the accuracy of all information recorded in logbooks, labels, or COC records.

3-4.0 SAFETY CONSIDERATIONS

Environmental samples may consist of, or may be preserved with, caustics and/or acids that can cause burns if the material should come in contact with the skin. The sample collection site may introduce additional health and safety concerns. Entering the site and/or the handling of samples should always be done with care, using the appropriate personal protective equipment (PPE). Prior to entering the site or handling samples or chemical preservatives, each TRC staff member should read and understand corresponding Material Safety Data Sheets (MSDSs), the TRC corporate Health and Safety Plan, and any project-specific Health and Safety procedures. Compliance with all applicable PPE and other health and safety procedures presented in these documents must be a priority of each sample collection effort.

3-5.0 EQUIPMENT

The following equipment may be utilized when documenting sample collection and transfer of custody:

- Analytical lab or TRC Chain of Custody forms
- TRC sample labels
- Custody seals
- Field Logbooks
- Indelible ink pen

3-6.0 TRAINING AND/OR QUALIFICATIONS

All persons performing the activities described in this SOP must have read and have an understanding of the contents. The individual must previously be instructed in the safe handling of chemicals. An understanding of project-specific plans (e.g., Field Sampling Plan, Quality Assurance Project Plan, etc.) and requirements is also recommended. It is required that a person collecting samples for the first time do so with supervision from an experienced sample collection specialist.

STANDARD OPERATING PROCEDURE

Title: **Packaging and Shipping of Environmental Samples**	*Procedure Number:* **No. 4.0**
Project: **Falcon Refinery Superfund Site, Ingleside, TX**	*Revision Number:* **0.0**
Reason for Revision: **NA**	*Revision Date:* **March 2011**

4-1.0 PURPOSE, SCOPE, & APPLICABILITY

This Standard Operating Procedure (SOP) was prepared to inform TRC personnel of the packaging and shipping requirements for environmental samples derived during field investigations. The term "Environmental Sample" refers to any sample that has less than reportable quantities of any hazardous constituents according to Department of Transportation (DOT) regulations, Title 49 CFR - Section 172.

Proper packaging and shipping is necessary to ensure the protection of the integrity of environmental samples shipped for analysis. The objective of this standard operating procedure (SOP) is to establish packaging and shipping requirements and guidelines for environmental sample shipping.

4-2.0 PROCEDURES

4-2.1 *SAMPLE CUSTODIAN RESPONSIBILITIES*

Each day during the field activities, the field team leader will designate a sample custodian. The primary responsibility of the sample custodian is to assure that the samples collected during the field investigation are properly labeled, packaged, and shipped to the appropriate laboratory. The following is an outline of the sample custodian's daily tasks:

- The sample custodian will allow enough time at the end of each day to double check each sample to assure that the sample is labeled correctly.
- The sample custodian will properly package samples inside an appropriate cooler.
- The sample custodian will fill out a chain-of-custody (COC) indicating which sample will be sent to the laboratory for analysis. If COC's are filled out during sampling, it will be the responsibility of the sample custodian to double-check the samples to the COC for proper identification.
- The sample custodian will properly seal the cooler for shipment.
- The sample custodian will properly complete the appropriate shipping papers.
- The sample custodian will bring the coolers containing the collected samples to the appropriate Federal Express shipping location.

4-2.2 *PACKAGING PROCEDURES*

The following steps must be followed when packing environmental samples for shipment by air:

1. Select a sturdy cooler in good condition. Secure and tape the drain plug with duct tape.

2. Be sure the caps on all bottles are tight (will not leak); check to see that labels and chain-of-custody records are completed properly.

3. Place all bottles in separate and appropriately sized plastic zip-top bags and close the bags. Up to three volatile organic analysis vials may be packed in one bag. Bottles may be wrapped in bubble wrap. It is preferable to place glass sample bottles and jars into the cooler vertically. Due to the strength properties of a glass container, there is much less chance for breakage when the container is packed vertically rather than horizontally.

4. Place bubble wrap or packing material into the bag in the cooler and then place the bottles and cans in the bag with sufficient space to allow for the addition of more packing material between the bottles and cans.

5. Put ice in large plastic zip-top bags and properly seal. Place these ice bags on top of and between the samples. Fill all remaining space between the bottles or cans with packing peanuts, bubble wrap, or vermiculite.

6. Place the completed Chain-of-Custody Record (see TRC SOP No. 3.0) and Performance Evaluation Sample instructions, if applicable, for the laboratory into a plastic zip-top bag, tape the bag to the inner side of the cooler's lid, and then close the cooler.

7. Strapping tape shall be wrapped around each end of the cooler two times, and completed custody seals affixed to the top on adjacent sides of the cooler. Place the custody seal so that the cooler cannot be opened without breaking the seal. Place clear shipping tape over the custody seals.

8. A label containing the name and address of the shipper shall be placed on the outside of the container, preferably using a handle-tag or secured with extra tape across the top of the cooler.

4-3.0 QUALITY CONTROL PROCEDURES

Accurate completion of labels and forms will be verified prior to transfer of sample custody. The Field Team Leader will be ultimately responsible for confirming the accuracy of all information recorded in logbooks, labels, or COC records.

4-4.0 SAFETY CONSIDERATIONS

Environmental samples may consist of, or may be preserved with, caustics and/or acids that can cause burns if the material should come in contact with the skin. The sample collection site may introduce additional health and safety concerns. Entering the site and/or the handling of samples should always be done with care, using the appropriate personal protective equipment (PPE). Prior to entering the site or handling samples or chemical preservatives, each TRC staff member should read and understand corresponding Material Safety Data Sheets (MSDSs), the TRC corporate Health and Safety Plan, and any project-specific Health and Safety procedures. Compliance with all applicable PPE and other health and safety procedures presented in these documents must be a priority of each sample collection effort.

4-5.0 EQUIPMENT

- Coolers,
- Heavy-duty plastic bags,
- Plastic zip-top bags, small and large,
- Tape (strapping, duct, and shipping),
- Vermiculite, packing peanuts, and/or bubble wrap,
- Ice,
- Chain-of-custody seals,
- Completed chain-of-custody record, and
- Completed bill of lading.

4-6.0 TRAINING AND/OR QUALIFICATIONS

All persons performing the activities described in this SOP must have read and have an understanding of the contents. The individual must previously be instructed in the safe handling of chemicals. An understanding of project-specific plans (e.g., Field Sampling Plan, Quality Assurance Project Plan, etc.) and requirements is also recommended. It is required that a person collecting samples for the first time do so with supervision from an experienced sample collection specialist.

4-7.0 REFERENCES

- Department of Transportation (DOT) regulations, Title 49 CFR - Section 172.

- *A Compendium of Superfund Field Operations Methods* (EPA/540/P-87/001)

STANDARD OPERATING PROCEDURE

Title: **Equipment Decontamination**	*Procedure Number:* **No. 5.0**
Project: **Falcon Refinery Superfund Site, Ingleside, TX**	*Revision Number:* **0.0**
Reason for Revision: **NA**	*Revision Date:* **March 2011**

5-1.0 PURPOSE, SCOPE, AND APPLICABILITY

This Standard Operating Procedure (SOP) was prepared to direct TRC personnel in the methods for decontamination of field equipment used in hazardous waste investigations.

The objective of equipment decontamination is to remove potential contaminants from a sampling device or item of field equipment prior to and between collection of samples for laboratory analysis and limit personnel exposure to residual contamination that may be present on used field equipment.

5-2.0 PROCEDURES

The following procedures should be used for decontaminating field equipment. Procedures will vary with equipment used and potential contaminants present at the site.

5-2.1 *GROUNDWATER SAMPLING EQUIPMENT*

Most equipment used for groundwater or soil collection should be dedicated or disposable. However, if necessary, sampling equipment, such as bailers and soil tools, will be cleaned using the following procedure:

1. Lay out sufficient polyethylene sheeting on the ground or floor to allow placement of the appropriate number of washbasins and room for air-drying. Place the wash basins on the sheeting.

2. Fill one washbasin with potable tap water. Add sufficient soap powder or solution to cause suds to form in the basin. Do not use an excessive amount of soap or rinsing the soap residue off the equipment will be difficult.

3. Wash the sampling equipment in the soap solution in the first basin, removing all residues. Allow excess soap to drain off the equipment when finished.

4. Rinse the equipment with tap water in a second basin.

5. Spray down the equipment in a third basin, using de-ionized water.

6. Allow the equipment to completely air dry on clean polyethylene sheeting.

7. Reassemble equipment, if necessary, and wrap completely in clean, unused aluminum foil, shiny side out for transport and/or storage. Re-use of equipment on the same day without wrapping in foil is acceptable.

8. Place spent cleaning solutions into the lined wastewater reservoir sump. Dispose of contaminated personal protective equipment appropriately.

Note that if temperature or humidity conditions preclude air-drying equipment, sufficient spares should be available so that no item of sampling equipment need be used more than once. Alternatively, the inability to air-dry equipment completely prior to reuse should be noted in the field log. In this case, additional rinses with de-ionized water should be used and recorded.

5-2.2 *OVERSIZED EQUIPMENT*

Oversized equipment, such as submersible pumps, will be cleaned using the following procedure:

1. Fill two clean barrels with tap water.

2. Add sufficient concentrated soap to one barrel to form a thin layer of soapsuds.

3. Immerse the pump in the soap-containing barrel and start pump. Circulate the soap solution through the pump and feed discharge into a waste disposal drum or into the municipal sewage disposal system.

4. Immerse the pump in the barrel filled with clean tap water and start pump. Circulate the water through the pump and feed discharge into a waste disposal drum. Run the pump until no soap residue is visible in the discharge.

5. De-ionized water should then be run through the pump and used to rinse all submersible parts and hoses.

6. Record the decontamination procedure in the field logbook or appropriate field form.

5-2.3 *MEASURING EQUIPMENT*

Measuring equipment, such as pressure transducers or water level indicators, will be cleaned using the following procedure:

1. Fill two clean basins with tap water.

2. Add sufficient concentrated soap to one basin to form a thin layer of soapsuds.

3. Immerse the device in the soap-containing basin and gently agitate. Scrub device if it is soiled. Do not submerse any electrical connectors or take-up reels, only that portion of the device in contact with potentially contaminated water.

4. Immerse the device in the basin containing the rinse water and gently agitate. Do not submerse any electrical connectors or take-up reels, only that portion of the device in contact with contaminated water.

5. Spray rinse equipment with de-ionized water.

6. Allow the equipment to air dry.

7. Record the decontamination procedure in the field logbook or appropriate field form.

5-3.0 QUALITY CONTROL PROCEDURES

Equipment blanks will be collected to check the effectiveness of the decontamination procedures. The equipment blank is a sample of analyte-free (distilled) water that is rinsed through the sampling equipment. It is collected after completion of decontamination and prior to sampling. This blank is used to document adequate decontamination of sampling equipment. Details of equipment blank collection procedure and rationale must be recorded in the field logbook in addition to the standard sample information entered (as described above). Equipment blanks are properly labeled and entered on the chain-of-custody.

5-4.0 SAFETY CONSIDERATIONS

Environmental samples may consist of, or may be preserved with, caustics and/or acids that can cause burns if the material should come in contact with the skin. The sample collection site may introduce additional health and safety concerns. Entering the site and/or the handling of samples should always be done with care, using the appropriate personal protective equipment (PPE). Prior to entering the site or handling samples or chemical preservatives, each TRC staff member should read and understand corresponding Material Safety Data Sheets (MSDSs), the TRC corporate Health and Safety Plan, and any project-specific Health and Safety procedures. Compliance with all applicable PPE and other health and safety procedures presented in these documents must be a priority of each sample collection effort.

5-5.0 EQUIPMENT

The following equipment may be utilized when decontaminating equipment. Site-specific conditions may warrant the use or deletion of items from this list.

- Alconox, Liqui-nox, or other non-phosphate concentrated laboratory grade soap.
- Tap water
- De-ionized water.
- Pump sprayer.
- Brushes or cleaning pads.
- Washbasins.
- Scrub brushes.
- Aluminum foil.
- Polyethylene sheeting.
- Two large capacity barrels.
- All necessary personal protective equipment (gloves, eyewear, Tyveks).

5-6.0 TRAINING AND/OR QUALIFICATIONS

All persons performing the activities described in this SOP must have read and have an understanding of the contents. The individual must previously be instructed in the safe handling of chemicals. An understanding of project-specific plans (e.g., Field Sampling Plan, Quality Assurance Project Plan, etc.) and requirements is also recommended. It is required that a person collecting samples for the first time, do so with supervision from an experienced sample collection specialist.

5-7.0 REFERENCES

- "A Compendium of Superfund Field Operations Methods” (EPA/540/P-87/001)

- 40 Code of Federal Regulations (CFR) Part 136, Guidelines for Establishing Test Procedures for the Analysis of Pollutants
- SW-846, Test Methods for Evaluating Solid Wastes Physical/Chemical Methods

Title: **Soil and Rock Core Description**	*Procedure Number:* **No 6.0**
Project: **Falcon Refinery Superfund Site, Ingleside, TX**	*Revision Number:* **0.0**
Reason for Revision: **NA**	*Revision Date:* **March 2011**

6-1.0 PURPOSE, SCOPE, AND APPLICABILITY

This Standard Operating Procedure (SOP) was prepared to direct TRC personnel of the methods for describing soil samples in soil borings.

All soils will be described using the Unified Soils Classification System (ASTM Designation D 2488-84: Standard Practice for Description and Identification of Soils [Visual-Manual Procedure]).

6-2.0 PROCEDURES

6-2.1 *SOIL DESCRIPTION*

Measure entire sample length and record recovery (as total footage recovered over total length that sampler was advanced) to the nearest tenth of a foot. Mark lithologic changes on logging form. Describe recovered material in accordance with the following soil description subsections.

Note depth to groundwater encountered on the logging form. Also note all visible contamination, odor, or any observed evidence of contamination in the sample. Record all observations and organic vapor analyzer (OVA) readings on the logging form. Also record VOC headspace readings for each logged interval.

If rotary-wash drilling methods are used, note the depth of any significant fluid loss, rate, and total volume, as applicable.

Record descriptions of the soil on the borehole log form (an example of a borehole log form is presented in Attachment A). To facilitate the comparison of logs, all descriptions should use a consistent order and style. The general description of a soil sample should be in the following order:

1. Color
2. ASTM testing results
3. Moisture content
4. Geologic modifiers or classifications
5. Major Constituent - capitalized
6. Minor Constituent
7. Geologic Description (in parentheses)

Example: Tan, loose wet stratified medium SAND, little fine sand, trace coarse sand, trace silt (glacial outwash).

When logging a soil sample collected from a split spoon when more than one soil material is present in the split spoon, describe each one separately, using an additional line(s) on the boring log form. Start the description from the top of the split spoon, and log each change in stratigraphy in sequence to the bottom of the spoon. Provide an interval or length (i.e., 0-5 ft.:) at the beginning of each separate sequence description, followed by a colon. Draw a line below the bottom of the complete sample description.

6-2.2 ***COLOR***

The main color value should be stated, along with an appropriate modifier such as light brown, dark brown, reddish brown, or brown. The presence of mottling should be included in the description, where present.

For example: Gray, slightly mottled, dense, damp, poorly sorted angular fine to medium SAND, some silt, trace angular coarse sand, trace clay (lodgement, glacial till).

6-2.3 ***MOISTURE CONTENT***

Moisture content should be described using the following modifiers:

Dry – absence of moisture, dusty, dry to touch.
Moist – very slight moisture content, no visible water.
Wet – saturated, visible free water.

6-2.4 ***GEOLOGIC MODIFIERS***

Sedimentological descriptions aid in the geologic classification of a soil material. Appropriate modifiers include:

- **Stratification -** the presence of alternating layers of non-cohesive materials of different grain sizes.
- **Lamination or varves -** the presence of alternating very thin layers of fine materials, such as silt and clay.
- **Sorting -** A geological term used to describe how close in size the grains in a sample are to each other. For example, a well sorted sample contains grains of similar size; a poorly sorted sample contains grains of many sizes.
- **Grading -** An engineering term used to describe the range in grain sizes present in a sample. For example, a narrowly graded sample contains grains of similar size; a widely graded sample contains grains of different sizes.
- **Angularity or rounding -** Geological terms that are used to describe the general appearance of visible grains in the soil sample. Useful in determining the origin and depositional environment of a material. Water transported materials may be rounded. Glacial tills will be more angular.

6-2.5 ***GRAIN-SIZE SCALES***

Grain size classification should be based on an accepted classification system such as the Unified Soil Classification System. The predominate grain size should be listed in the soil description in all capital letters. Example grain size classifications include:

- Boulder: > 300 mm
- Cobble: 75 - 300 mm
- C. Gravel: 19 - 75 mm
- F. Gravel: 4.75 - 19 mm
- C. Sand: 2.0 - 4.75 mm
- M. Sand: 0.425 - 2.0 mm
- F. Sand: 0.075 - 0.425 mm

- Silt: 0.002 - 0.075 mm
- Clay: <0.002 mm

6-2.6 *PROPORTIONS*

For geologic description, proportions of grain sizes will be based upon the following nomenclature:

- Trace: 0-10%
- Little: 10-20%
- Some: 20-35%
- Mostly: 35-50%

The major soil sample constituent is always capitalized and listed first. Minor constituents also include ancillary materials such as mica flakes, dark minerals, or naturally occurring organic matter, such as humus, peat, or other vegetative material.

6-3.0 SAFETY CONSIDERATIONS

Environmental samples may consist of, or may be preserved with, caustics and/or acids that can cause burns if the material should come in contact with the skin. The sample collection site may introduce additional health and safety concerns. Entering the site and/or the handling of samples should always be done with care and using the appropriate personal protective equipment (PPE). Prior to entering the site or handling samples or chemical preservatives, each TRC staff member should read and understand corresponding Material Safety Data Sheets (MSDSs), the TRC corporate Health and Safety Plan, and any project-specific Health and Safety procedures. Compliance with all applicable PPE and other health and safety procedures presented in these documents must be a priority.

6-4.0 EQUIPMENT

The following equipment may be necessary during soil description activities:

- Tape measure
- Munsell soil color chart
- Sand grading chart
- Ruler
- Table
- Polyethylene sheeting
- Hand lens
- Knife or spatula
- Dropper with 10% hydrochloric acid for calcium carbonate test
- Water
- Boring log forms, field logbook, and indelible pen
- Duct tape
- Health and safety equipment, as specified in the HSP

6-5.0 TRAINING AND/OR QUALIFICATIONS

All persons performing the activities described in this SOP must have read and have an understanding of the contents. The individual must previously be instructed in the safe handling of chemicals. An understanding of project-specific plans (e.g., Field Sampling Plan, Quality Assurance Project Plan, etc.) and requirements is also recommended. It is required that a person collecting samples for the first time, do so with supervision from an experienced sample collection specialist.

6-6.0 REFERENCES

- *A Compendium of Superfund Field Operations Methods* (EPA/540/P-87/001)
- 40 Code of Federal Regulations (CFR) Part 136, *Guidelines for Establishing Test Procedures for the Analysis of Pollutants*
- Unified Soils Classification System (ASTM Designation D 2488-84: Standard Practice for Description and Identification of Soils [Visual-Manual Procedure])

Title: **Shallow Depth Soil Sampling**	Procedure Number: **No. 7.0**
Project: **Falcon Refinery Superfund Site, Ingleside, TX**	Revision Number: **0.0**
Reason for Revision: **NA**	Revision Date: **March 2011**

7-1.0 PURPOSE, SCOPE, AND APPLICABILITY

This Standard Operating Procedure (SOP) was prepared to inform TRC personnel of the methods for the collection of representative soil samples at shallow depths. Sampling depths are assumed to be those that can be reached without the use of drill rig, direct-push, or other mechanized equipment. This method may be necessary when boring locations at a site are inaccessible to a drill or direct-push rig, or there is an insufficient amount of soil depth to warrant a rig. This method may be also used to collect sediment samples from streambeds.

7-2.0 PROCEDURES

7-2.1 *SURFACE SOIL SAMPLE COLLECTION*

Collection of samples from near-surface soil can be accomplished with tools such as spades, shovels, trowels, and scoops. Surface material is removed to the required depth and a stainless steel or plastic scoop is then used to collect the sample. As applicable, sampling equipment must be properly decontaminated prior to use, as specified in TRC SOP No. 5.0. This method can be used in most soil types but is limited to sampling at or near the ground surface.

The following procedure is used to collect surface soil samples:

1. Carefully remove the top layer of soil or debris to the desired sample depth with a pre-cleaned spade.

2. Collect the sample using a stainless steel spoon.

3. Do not add chemical preservatives to the soil samples. Pack the sample containers in coolers with ice to minimize volatilization and preserve the samples.

7-2.2 *SHALLOW DEPTH SAMPLE COLLECTION*

Collection of samples from shallow depths may be accomplished with a bucket type auger. This system consists of an auger, a series of extensions, and a “T” handle. The auger is used to bore a hole to a desired sampling depth, and is then withdrawn and the sample is collected. As applicable, sampling equipment must be properly decontaminated prior to use, as specified in TRC SOP No. 5.0.

The following procedure is used to collect shallow depth soil samples with the auger:

1. Attach the auger bit to a drill rod extension, and attach the “T” handle to the drill rod.

2. Clear the area to be sampled of any surface debris (e.g. twigs, rocks, litter). It may be advisable to remove the first three to six inches of surface soil for an area approximately six inches in radius around the drilling location.

3. Advance the auger to the desired sampling depth, rotating the auger clockwise by hand. If necessary, periodically remove and deposit accumulated soils onto a plastic sheet spread near the hole to prevent accidental brushing of loose material back down the borehole when removing the auger.

4. After reaching the desired depth, slowly and carefully remove the auger from the hole. Collect the sample after the auger is removed from the hole.

5. If another sample is to be collected in the same hole, but at a greater depth, reattach the auger assembly and follow steps 3 through 5, making sure to decontaminate the auger between samples.

7-2.3 *POST SAMPLING REQUIREMENTS*

After sampling, use all removed soils to fill in the sampling holes as much as possible. Drum and dispose of soil that does not fit into the sampling hole in accordance with the QAPP. Mark the boring location with a clearly labeled stake or flag that indicates the site and sample location number.

7-3.0 QUALITY ASSURANCE/QUALITY CONTROL

All data must be documented on field data sheets or within site logbooks. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

7-4.0 SAFETY CONSIDERATIONS

Environmental samples may consist of, or may be preserved with, caustics and/or acids that can cause burns if the material should come in contact with the skin. The sample collection site may introduce additional health and safety concerns. Entering the site and/or the handling of samples should always be done with care and using the appropriate personal protective equipment (PPE). Prior to entering the site or handling samples or chemical preservatives, each TRC staff member should read and understand corresponding Material Safety Data Sheets (MSDSs), the TRC corporate Health and Safety Plan, and any project-specific Health and Safety procedures. Compliance with all applicable PPE and other health and safety procedures presented in these documents must be a priority of each sample collection effort.

7-5.0 EQUIPMENT

- Site map and/or global positioning system (GPS)
- Tape measure
- Survey stakes or flags
- Stainless steel bowls and trowels/spoons for homogenizing
- Re-sealable plastic bags
- Spade or shovel
- Augers (continuous flight, bucket, and/or post hole)
- Extension rods
- T-handle
- Plastic sheeting
- Health and safety and personal protective equipment

- Decontamination supplies
- Sample containers, preservatives, coolers, labels, and ice
- Field documentation equipment (log books and log sheets, indelible pen)

7-6.0 TRAINING AND/OR QUALIFICATIONS

All persons performing the activities described in this SOP must have read and have an understanding of the contents. An understanding of project-specific plans (e.g., Field Sampling Plan, Quality Assurance Project Plan, etc.) and requirements is also recommended.

7-7.0 REFERENCES

- U.S. EPA Environmental Response Team, *SOP: Soil Sampling*, February 2000.

Title: Geoprobe Sampling	*Procedure Number:* No. 8.0
Project: Falcon Refinery Superfund Site, Ingleside, TX	*Revision Number:* 0.0
Reason for Revision: NA	*Revision Date:* March 2011

8-1.0 PURPOSE, SCOPE, AND APPLICABILITY

This Standard Operating Procedure (SOP) was prepared to direct TRC personnel in the collection of soil samples utilizing a Geoprobe Macro Core Sampling system with a 2" split spoon sampler that has been modified to work with the 1.5" or 1.75" DPT rod. The split spoon samplers come in 2' and 3' lengths. Both types of sampling systems can be lined with clear acetate sleeves, or brass or stainless brass rings. Sand catchers are used when loose sediment is encountered.

8-2.0 PROCEDURES

8-2.1 *PRE-DRILLING REQUIREMENTS*

Before conducting borings, TRC will conduct the appropriate utility clearance and site reconnaissance specified in SOP 1.0, with no exceptions. The exact location of each boring shall also be reviewed by responsible personnel to ensure that the area is free of the TxDOT or city buried items.

The supervising geologist/engineer shall record the name of the drilling firm and the names of the driller and his assistant(s). The date, project location, project number, and weather conditions shall be recorded as well.

An accurate time log of drilling activities shall be kept. This log shall be kept in the field logbook and shall include at a minimum, the following:

- Time driller and rig arrive on-site,
- Time drilling begins,
- Any delays in the drilling activities and the cause of such delays,
- Time drillers go off-site, and
- Down time (periods when drilling activities cease due to equipment malfunctions, weather, and/or ordered stoppages).

8-2.2 *SPLIT SPOON SAMPLING (OPEN BARREL)*

When sampling above the water table in competent strata, an open ended split spoon is driven into the formation in 2' or 3' intervals. After the bottom of the sampling interval has been reached, the probe rod is withdrawn from the bore hole along with the sampler. The cutting shoe is removed and the sample (encased in the acetate or metal sleeves) is withdrawn. A clean sampler is loaded with a new liner, a clean cutting shoe is screwed onto the end of the sampler, and the sampler and probe rod are run back into the bore hole to advance through the next core interval. The process is repeated until the target interval has been cored or the core barrel encounters probe refusal. Intervals may be skipped by tripping into the hole with a 2" pre-probe assembly in place of the sampler.

8-2.3 *SPLIT SPOON SAMPLING (CLOSED BARREL)*

If the formation is unconsolidated, where sloughing becomes a problem, or when sampling below the water table, the sampler can be closed by using a latching, piston-sampler unit. With the piston locked in place with a set screw at the top of the sampler, the closed sampler can be driven through the shallower zones to the target depth. The sampler is then opened by unscrewing the set screw with control rods that have been lowered into the probe rod. After the release, the sampler is driven through the sample interval.

8-2.4 *DECONTAMINATION PROCEDURES*

Decontamination procedures vary from site to site, based on the ultimate objectives or the type of contaminants involved. At a bare minimum, the sampler and probe rod will be washed with an Alconox or Liqi-nox solution and rinsed with distilled water between each boring. The cutting shoe is cleaned between each interval. This procedure is accomplished with 5 gallon buckets which are placed on plastic to contain over spray.

At the other end of the decon spectrum, a decon pad is built for a high pressure steam cleaner. The back of the probing unit and all down hole tools are steam cleaned with an Alconox (Liqui-nox) solution prior to moving onto a site and between each sampling location. The tools are triple rinsed with DI water, methanol and hexane, and allowed to air dry. The samplers are wrapped in aluminum foil prior to use. Clean samplers are used for each sample interval. The waste water is pumped out of the containment area and placed into drums for transportation or storage.

8-3.0 QUALITY ASSURANCE/QUALITY CONTROL

All data must be documented on field data sheets or within site logbooks. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

8-4.0 SAFETY CONSIDERATIONS

Environmental samples may consist of, or may be preserved with, caustics and/or acids that can cause burns if the material should come in contact with the skin. The sample collection site may introduce additional health and safety concerns. Entering the site and/or the handling of samples should always be done with care, using the appropriate personal protective equipment (PPE). Prior to entering the site or handling samples or chemical preservatives, each TRC staff member should read and understand corresponding Material Safety Data Sheets (MSDSs), the TRC corporate Health and Safety Plan, and any project-specific Health and Safety procedures. Compliance with all applicable PPE and other health and safety procedures presented in these documents must be a priority of each sample collection effort.

8-5.0 EQUIPMENT

- Subcontractor-supplied boring equipment
- Decontamination supplies
- Health and safety and personal protective equipment
- Sample containers, preservatives, coolers, labels, and ice
- Field documentation equipment (log books and log sheets, indelible pen)

8-6.0 TRAINING AND/OR QUALIFICATIONS

All persons performing the activities described in this SOP must have read and have an understanding of the contents. An understanding of project-specific plans (e.g., Field Sampling Plan, Quality Assurance Project Plan, etc.) and requirements is also recommended.

8-7.0 REFERENCES

- *A Compendium of Superfund Field Operations Methods* (EPA/540/P-87/001).

Title: **Hollow-Stem Auger Soil Sampling**	*Procedure Number:* **No. 9.0**
Project: **Falcon Refinery Superfund Site, Ingleside, TX**	*Revision Number:* **0.0**
Reason for Revision: **NA**	*Revision Date:* **March 2011**

9-1.0 PURPOSE, SCOPE, AND APPLICABILITY

This Standard Operating Procedure (SOP) was prepared to direct TRC personnel in the methods for hollow-stem auger (HSA) sampling for soil. This method involves advancing hollow-stemmed augers with large mobile equipment. Auger borings are cost effective and do not involve the introduction of drilling fluid or mud to the subsurface environment. HSA techniques will be used at locations where soil samples will be collected prior to installing permanent monitoring wells.

The objective of hollow-stem auger boring is to provide samples for description and characterization of subsurface conditions and for geotechnical and chemical analyses. This objective requires the use of consistent procedures for documenting observations and collecting samples.

9-2.0 PROCEDURES

9-2.1 *PRE-DRILLING REQUIREMENTS*

Before conducting borings, TRC will conduct the appropriate utility clearance and site reconnaissance specified in TRC SOP No. 1.0, with no exceptions. The exact location of each boring shall also be reviewed by responsible personnel to ensure that the area is free of the TxDOT or city buried items.

The supervising geologist/engineer shall record the name of the drilling firm and the names of the driller and his assistant(s). The date, project location, project number, and weather conditions shall be recorded as well.

An accurate time log of drilling activities shall be kept. This log shall be kept in the field logbook and shall include at a minimum, the following:

- Time driller and rig arrive on-site,
- Time drilling begins,
- Any delays in the drilling activities and the cause of such delays,
- Time drillers go off-site, and
- Down time (periods when drilling activities cease due to equipment malfunctions, weather, and/or ordered stoppages).

9-2.2 *HSA Boring*

Hollow-stemmed augers are advanced hydraulically into the overburden to the required sampling depth. The auger acts as a casing during the advancement of the borehole. A removable center plug allows passage of the sampling equipment (typically a split-spoon sampler) to the required depth. Augers are usually in five-foot sections. Some disturbances of the sampling zone may be created during the augering operation.

Drillers commonly dislike using the center plug and often attempt to complete the boring without using one. However, the center plug should always be used to prevent soil from entering the auger. If a center plug is not used, the split-spoon sampler may not be located at the desired sampling depth due to the presence of soil inside the auger.

9-2.3 *HSA Soil Sampling*

Where details of subsurface conditions are necessary, soil sampling shall be conducted using a split-spoon penetration sampler, driven with a 140-pound hammer with a free-fall of 30 inches. This is a standard method of soil sampling as described in ASTM D1586. If necessary, the length of the hammer shaft will be measured and marked to ensure a minimum drop of 30 inches. This technique should be conducted as follows:

1. The split-spoon sampler (spoon) consists of a 2-inch (outside diameter) by1-3/8 inch (inside diameter), 18-inch to 24-inch length, heat-treated, case-hardened steel head, split-spoon, and shoe assembly. Split-spoon or split-tube samplers are the most generally accepted method for obtaining representative, undisturbed soil samples. The head is vented to prevent pressure buildup during sampling and must be kept clean. A steel ball watercheck valve is located in the head to prevent downward water pressure from acting on the sample. Removal of the watercheck frequently causes sample loss.

2. The drive rods that connect the spoon to the drive head should have stiffness equal to or greater than that of the A-rod. In order to maintain only minimal rod deflection, on exceptionally deep holes, it may be preferable to use N-rods. The size of the drive rods must be kept constant throughout a specific exploration program, as the energy absorbed by the rods will vary with the size and weight of the rod employed. This is important in geotechnical investigation.

3. The drive head consists of a guide rod to give the drop hammer (140 pounds) free fall in order to strike the anvil attached to the lower end of the assembly. The guide rod must be at least 3.5 feet in length to insure the correct hammer drop.

4. The drop hammer used in determining SPT resistance must weigh 140 pounds and have a 2.5-inch diameter hole through the center, for passage of the drive head guide rod.

5. The hammer is raised with a rope activated by the drill rig cathead; no more than 2 turns of the rope should be allowed on the cathead. A 30-inch hammer drop is mandatory for proper SPT determination. Extreme care must be exercised to produce consistent results. Automatic trip hammers are commercially available which insure the 30-inch free-fall drop. When presentation of the soil structure is critical (such as in liquefaction studies), the automatic trip hammer should be employed.

6. Attach the split-spoon sampler to the drill rods and lower the assembly to the bottom of the borehole. Measure the drill rod stickup to determine if heave or blow-up of the stratum has occurred. Note any penetration of the sampler into the stratum under the weight of the rods. The 140-pound hammer is raised 30 inches above the drivehead anvil and then allowed to free fall and strike the anvil. This procedure is repeated until the sampler has penetrated the full length of the sampler (18 to 24 inches depending on the sampler) into the stratum at the bottom of the borehole.

7. The number of blows of the hammer required for each 6-inch penetration is counted and recorded on the boring log. A penetration rate of 100 blows per foot is normally considered refusal; however, this criterion may be varied depending upon the desired information. The penetration resistance (N) is determined by adding the second and third 6-inch resistance blow counts together. When other sizes and types of sampling and drive equipment are employed, ASTM reference tables may be used in converting the obtained blow count to the accepted SPT value.

8. The sampler is then withdrawn from the borehole, preferably by pulling on the rope. If the sampler is difficult to remove from the stratum, it may be necessary to remove it by hitting the drive head upward with short, light hammer strokes. Remove the sampler from the bottom of the borehole slowly to minimize disturbance. Keep the casing full of water during the removal operation.

9. Careful measurement of all drilling tools, samplers, and casing must be exercised during all phases of the test boring operations, to insure maximum quality and recovery of the sample.

10. The supervising geologist/engineer shall record, at a minimum, the weight of the hammer, the length of the split spoon sampler, and the number of hammer blows on the spoon per 6 inches of penetration.

11. Upon removal of the sampler, the earth materials shall be logged in accordance with TRC SOP No. 6.0. The split-spoon is opened and carefully examined, noting all soil characteristics, color seam, disturbance, etc.

12. If it is the appropriate depth or conditions, a sample shall be collected according to the following procedures.

    a. Collect samples for volatile organic compound (VOC) analysis first to minimize the potential for volatilization. Use a pre-cleaned stainless steel spoon to collect a sufficient amount of soil directly into the VOC sample containers. Glass jars with Teflon ®-lined lids will be used for VOC samples. Pack the sample container completely full to reduce the amount of headspace, which will minimize the loss of volatile compounds, and secure lid immediately. Alternatively, collect VOC samples using EnCore® (or equivalent) sample collection devices per SW846 Method 5035.

    b. Collect soil and place it in a foil covered 120-mL jar or re-sealable plastic bag for VOC headspace analysis.

    c. Collect samples for the remaining analyses. For samples that will not be analyzed for VOCs, composite the remaining soil by carefully mixing with a decontaminated stainless steel spoon. Divide the composited sample into aliquots of equal size, corresponding to the number of required sample containers. Collect samples for the remaining analyses in the following order:

        i. Semivolatile Organic Compounds (SVOCs)
        ii. Inorganics

iii. Physical parameters

d. Use the stainless steel spoon to place each aliquot into the appropriate containers (see the FSP) and secure each container immediately with a Teflon®-lined lid.

e. Complete the sample labels as specified in TRC SOP No. 3.0. Wipe the container with a paper towel prior to affixing the sample label.

f. Do not add chemical preservatives to the soil samples (unless collection protocols for Method 5035 VOC samples require field preservation). Pack the sample containers in coolers with ice to minimize volatilization and preserve the samples.

13. Continue sampling at additional depth intervals or abandon the borehole, as appropriate for the location. Alternately, when the number of blow counts exceeds 50 per 6 inches, the split spoon sampling shall be terminated and the number of blow per tenths of foot (for the last one-half foot) shall be recorded and noted as sampler refusal.

After the samples have been collected, a monitoring well will be installed, if appropriate, or the borehole will be abandoned. Monitoring wells shall be installed according to the procedures described in TRC SOP No. 10.0. If the boring is abandoned, it will be backfilled with cement/bentonite or cement and the approximate location of the boring will be marked with a wooden stake colored with highly visible spray paint. The boring number will also be written on the stake to identify the sample location for surveying purposes.

9-3.0 QUALITY ASSURANCE/QUALITY CONTROL

All data must be documented on field data sheets or within site logbooks. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation and must be documented.

9-4.0 SAFETY CONSIDERATIONS

Environmental samples may consist of, or may be preserved with, caustics and/or acids that can cause burns if the material should come in contact with the skin. The sample collection site may introduce additional health and safety concerns. Entering the site and/or the handling of samples should always be done with care and using the appropriate personal protective equipment (PPE). Prior to entering the site or handling samples or chemical preservatives, each TRC staff member should read and understand corresponding Material Safety Data Sheets (MSDSs), the TRC corporate Health and Safety Plan, and any project-specific Health and Safety procedures. Compliance with all applicable PPE and other health and safety procedures presented in these documents must be a priority of each sample collection effort.

9-5.0 EQUIPMENT

- Subcontractor-supplied boring equipment
- Decontamination supplies
- Health and safety and personal protective equipment
- Sample containers, preservatives, coolers, labels, and ice
- Field documentation equipment (log books and log sheets, indelible pen)

9-6.0 TRAINING AND/OR QUALIFICATIONS

All persons performing the activities described in this SOP must have read and have an understanding of the contents. An understanding of project-specific plans (e.g., Field Sampling Plan, Quality Assurance Project Plan, etc.) and requirements is also recommended

9-7.0 REFERENCES

- ASTM Standard Method D1586-98, *"Standard Test Method for Penetration Test and Split Spoon Sampling.*

- *A Compendium of Superfund Field Operations Methods* (EPA/540/P-87/001).

Title: Monitoring Well Installation and Development	Procedure Number: No. 10.0
Project: Falcon Refinery Superfund Site, Ingleside, TX	Revision Number: 0.0
Reason for Revision: NA	Revision Date: March 2011

10-1.0 PURPOSE, SCOPE, AND APPLICABILITY

This Standard Operating Procedure (SOP) was prepared to inform TRC personnel of the methods for the installation and development of monitoring wells. Monitoring wells will be installed in order to collect representative samples of groundwater, to measure the static water level, and/or to conduct various types of aquifer tests for the determination of aquifer parameters (hydraulic conductivity, storativity, etc.). All monitoring wells will be constructed in a manner that complies with all applicable federal, state, and local regulations.

10-2.0 PROCEDURES

10-2.1 *PREPARATION*

Prior to the initiation of field work the project manager, field hydrogeologist, or field technical lead (site manager) will secure the services of a qualified drilling contractor. A contract between TRC and the drilling contractor will be executed before mobilization. The drilling contractor must meet the following requirements:

- Have the appropriate licenses and registrations
- Have the proper equipment available to perform the type of drilling required
- Have personnel who are OSHA-trained to work on hazardous waste sites and are willing to participate in the appropriate medical monitoring for the site

Before the start of field tasks, the field hydrogeologist or field technical lead is responsible for coordinating the following items with the drilling contractor personnel.

- Familiarizing the contractor with the objectives of the investigation
- Providing and reviewing of a copy of the project work plan with the contractor
- Providing and reviewing of a copy of the project health and safety plan with the contractor
- Performing a daily health and safety review with the contractor

Compliance with all state and federal requirements is required prior to the installation of monitoring wells. The field hydrogeologist or project manager is responsible for obtaining all required permits. These permits may include, but are not limited to, the following:

- Notification and approval to drill/install a monitoring well
- Registration of the well
- Permit for water withdrawals
- Well abandonment when the project is completed
- State specified dig-safe permits

10-2.2 *MONITORING WELL INSTALLATION*

Boreholes to be completed as monitoring wells will be advanced and logged in accordance with TRC SOP No. 6.0. Equipment used to advance the boring and install the monitoring well will be decontaminated prior to the start of the boring using the procedures in TRC SOP No. 5.0. All well materials that do not appear to be factory cleaned and sealed or those that have become open during shipment to the site will be steam cleaned prior to use at the site.

The drilling subcontractor under the direction of a qualified TRC geologist or engineer will install monitoring wells. Monitoring wells will be installed using the following general procedures, which may be dependent on the site-specific requirements.

1. The construction details of the well to be installed will be provided to the driller, including well material, screen length, slot size, riser length, depth of the well, sand pack, bentonite seal, grouting requirements, and surface well completion.

2. All well materials will be inspected to ensure that they are clean prior to installation.

3. Sections of screen and riser will be threaded together and lowered into the borehole. Centralizers may be used in deeper wells to ensure proper well placement within the borehole.

4. The selected well packing materials will be introduced into the annulus in a manner so as to ensure an adequate well pack and seal. The thickness of each layer of well pack material will be measured with a weighted string and recorded. All augers or casing will be removed sequentially during sand pack installation and the well will remain at the desired depth during auger or casing withdrawal.

5. The bentonite seal installation technique will vary with the depth of the water table. The appropriate type of bentonite (pellets, chips, or slurry) will be selected to suit the objectives of the installation program. In general, the seal will be installed above the sand pack so that a thickness of two to three feet is installed. Bentonite seals in shallow wells installed across the water table will be hydrated and allowed to swell prior to the emplacement of a cement-bentonite grout mixture.

6. A cement-bentonite grout will be emplaced to fill the annulus of the boring. Dependent on the depth of the well and water table, the grout may be tremied into the desired location. The grout mixture (percentage of cement to bentonite) will be recorded. The grout will be pumped into the boring around the well materials to the surface. If necessary, after solidification of the grout and settling occurs, the grout may need to be topped off with additional grout mixture. The need for additional grout will be based on the intended surface completion for the well.

7. Depending on the location of the well, flush-mounted road boxes or steel protective casings with locking cap will be recommended and cemented in place as described in Section 5.2.6 above. Once completed, the well will be locked and allowed to settle prior to well development.

8. All information concerning the well installation details will be recorded in the field logbook.

10-2.3 *MONITORING WELL DEVELOPMENT*

Monitoring well development is completed in order to establish a good hydraulic connection between the well screen and the surrounding aquifer, settle the sand pack and formation from drilling, and removal of the fine particles (silt) from the water column and sand pack in order to obtain groundwater samples that are representative of the aquifer in which the well is installed.

Well development will be completed on monitoring wells after the grout, annular seals, and protective casings are stable (i.e., 48 hours after installation), according to the following procedure.

1. Consult the monitoring well completion diagram and boring logs to determine the well construction geometry (depth and length of screen), air monitoring results, material screened, and depth to water. If potable water has been used during well installation, the estimated amount of water lost to the formation during the drilling process should be removed prior to the initiation of well development to ensure the removal of fresh formation water during the development process.

2. Select the appropriate device and tubing to complete development. The apparatus selected should be capable of surging the entire length of the well screen and be equipped with enough discharge tubing and water withdrawal capability to complete well evacuation to the surface and into containers if required.

3. Select the appropriate device and tubing to complete development. The apparatus selected should be capable of surging the entire length of the well screen and be equipped with enough discharge tubing and water withdrawal capability to complete well evacuation to the surface and into containers if required.

4. Measure the static water level in the well and determine the amount of standing water in the well (well volume). Record the air readings, water level, and calculated single well volume.

5. Using the appropriate length of dedicated or decontaminated hosing/tubing and the selected pumping apparatus, insert the equipment into the well.

6. Initiate water removal from the well and record the initial field water quality measurements of pH, temperature, conductivity, and turbidity on the well development form. Record any odors, watercolor, increases in air monitoring results or other observations in the field logbook.

7. Continue to evacuate the well while surging the water in the well screen into and out of the sand pack. Using a plastic beaker or jar to collect purged water, conduct and record the field water quality parameters, as in No. 6 above, with each successive well volume as well as any additional observations. Rinse measurements probes with de-ionized water between

successive measurements and rinse with the purged water prior to the measurement of each well volume. Water should be withdrawn from the well until three successive measurements of field water quality measurements vary by less than 10% of the each other. During this procedure, the water clarity and turbidity should be closely monitored. Typically, following initially turbid results, turbidity values will decrease with the removal of subsequent well volumes; however, stabilization of the turbidity values in silty aquifers may be difficult. Well development should proceed until turbidity values have stabilized to within 10%.

8. Once all the development criteria have been satisfied, remove the apparatus from the well and complete decontamination of the apparatus and probes in accordance with TRC SOP No. 5.0.

10-2.4 *PURGE WATER MANAGEMENT*

The purge water generated at each well should be drummed. Samples from the drums may be analyzed for characterization purposes. The drummed water must be disposed according to all applicable regulations.

10-3.0 WELL CONSTRUCTION MATERIALS

In general, all well materials (other than filter sand, seals, and grout) will be cleaned with a high pressure, hot water wash, rinsed with de-ionized water, and sealed in plastic bags. Decontamination and bagging can be conducted by the manufacturer, prior to delivery to the site. Alternatively, the contractor or TRC may decontaminate the materials at an off-site location and deliver them to the site in a protective wrap.

Well Screen

Monitoring well screens will typically consist of two-inch diameter, flush-threaded, Schedule 40, polyvinyl chloride (PVC), machine-cut slotted screen. Other materials or sizes may be specified in the work plan as required by site conditions or local regulations. If the well is to be used for in-situ hydraulic conductivity testing as well as groundwater sampling, wire-wrap type screen construction is recommended over machine-slotted screen, to increase screen open area and ensure that the screen does not inhibit the flow of water into or out of the well. The screen slot size should be selected to retain a minimum of 90 percent of the filter pack material.

Riser and End Caps

Monitoring well riser and end caps will consist of two-inch diameter, flush-threaded, Schedule 40, PVC. Other materials or sizes may be specified in the work plan as required by site conditions or local regulations. The top cap will have a small hole drilled through it to allow the passage of air, unless the well is to be installed at ground level. In that case, the top of the well shall be sealed with an expansion cap, to prevent the inflow of runoff into the well.

Filter Pack

A filter pack will be required in any formation other than coarse sand and gravels containing less than ten percent fines (silts and clays) by weight. In such formations, the use of an artificial sand pack may be optional. The purpose of the filter pack is to inhibit the flow of fines into the well screen, allowing production of groundwater optimal for groundwater quality analyses.

Where an artificial filter pack is required, the filter material shall be composed of a washed, graded, commercially produced silica sand. The uniformity coefficient (C_u) of the filter pack will be no less than 1 and no more than 2, to prevent segregation of the filter material when it is installed in the well. The grain size of the filter pack shall be no less than 3 and no more than 6 times the D_{30} (passing) of the finest geologic unit in which the well is to be screened. A multiplier of 3 shall be used if the formation is fine and uniform, and 6 if the formation is coarse and non-uniform. The D_{30} grain size of the formation should be determined by laboratory sieve grain-size analysis. If laboratory grain-size analysis cannot be performed, a variety of sand packs should be available, based upon known geological information of the site. Based upon field estimates of grain size distribution, a sand pack will be selected that matches the above criteria.

Seal

The seal will consist of bentonite clay pellets, chips, donut, or slurry, sufficient to form a two-foot-thick seal above the filter pack. The selection of the form of bentonite clay will depend upon the project budget, location of the top of the filter pack relative to the water table, and site-specific requirements. The seal will be hydrated with potable analyte-free water.

Grout

The annular space above the bentonite seal and the ground surface shall be grouted with a mixture of 95 percent Portland cement or equivalent, and 5 percent bentonite grout, mixed with potable water to the specifications of the concrete manufacturer.

Surface Protective Casing

The surface casing shall consist of galvanized steel or steel coated with a rustproof coating. The surface casing shall have a hinged cap with provision for a lock. The base of the casing, at the point where it shall extend above the concrete pad, shall have a small weep hole drilled through the casing to prevent the build-up of precipitation or ice between the steel casing and well riser.

10-4.0 QUALITY ASSURANCE/QUALITY CONTROL

All data must be documented on field data sheets or within site logbooks. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

10-5.0 SAFETY CONSIDERATIONS

The work site may introduce health and safety concerns. Entering the site with care and using the appropriate personal protective equipment (PPE). Prior to entering the site, each TRC staff member should read and understand corresponding Material Safety Data Sheets (MSDSs), the TRC corporate Health and Safety Plan, and any project-specific Health and Safety procedures. Compliance with all applicable PPE and other health and safety procedures presented in these documents must be a priority of each project field effort.

10-6.0 EQUIPMENT

The monitoring well installation/drilling subcontractor will need a copy of the Field Sampling Plan, Quality Assurance Project Plan, and/or appropriate health and safety gear. The subcontractor will provide all additional equipment and materials. Equipment should include at minimum the items specified in the following subsections.

10-6.1 *MONITORING WELL INSTALLATION EQUIPMENT (DRILLERS)*

Monitoring well equipment supplied by the subcontractor includes:

- Drill rig
- Grout mixing and pumping equipment, including a side emptying discharge attachment
- Well materials
- 10-ft and 5-ft lengths of 2-in.-diameter, flush-threaded, Schedule 40 PVC well screen with 0.01-in. slots and flush threads
- 2-in.-diameter, flush-threaded, Schedule 40 PVC
- Centralizers
- Washed silica, #10-20 grade filter sand
- 1/4-in. sodium bentonite pellets
- Neat cement grout (3-5% bentonite powder, 94 lbs. portland cement, and 7 gal. water)
- Locking steel protective casing and guard posts or flush boxes
- Concrete
- Protective steel posts (3-in. diameter.)
- Vented surge block and bailer
- Decontamination supplies
- Health and safety equipment as specified in the HSP

10-6.2 *MONITORING WELL INSTALLATION EQUIPMENT (TRC)*

Monitoring well equipment supplied by TRC includes:

- Field documentation equipment (log books and log sheets, indelible pen)
- Site map and/or global positioning system (GPS)
- Monitoring well construction diagram
- Weighted measuring tape
- Electric water level meter (E-line)
- Health and safety equipment as specified in the HSP
- Decontamination supplies

10-7.0 TRAINING AND/OR QUALIFICATIONS

All persons performing the activities described in this SOP must have read and have an understanding of the contents. An understanding of project-specific plans (e.g., Field Sampling Plan, Quality Assurance Project Plan, etc.) and requirements is also recommended.

10-8.0 REFERENCES

- A Compendium of Superfund Field Operations Methods (EPA/540/P-87/001)

STANDARD OPERATING PROCEDURE

Title: **Synoptic Water Level Measurement**	*Procedure Number:* **No. 11.0**
Project: **Falcon Refinery Superfund Site, Ingleside, TX**	*Revision Number:* **0.0**
Reason for Revision: **NA**	*Revision Date:* **March 2011**

11-1.0 PURPOSE, SCOPE, AND APPLICABILITY

This Standard Operating Procedure (SOP) was prepared to direct TRC personnel in the methods for conducting water/product level measurements in monitoring wells during field investigations and projects at hazardous and non-hazardous waste sites.

The objective of water level measurements is to gain accurate measurements of the depth of groundwater for use during well installation, in the recording of data for the preparation of groundwater elevation contour maps, purge volume calculations during groundwater sampling, slug tests, packer tests, and pump tests.

The objective of product level measurements is to obtain the thickness of product in a well. Synoptic water level measurement is the measuring of water levels in all monitoring wells within a specified period of time (e.g., 12 hours), with the objective of obtaining accurate characterization of site hydrology.

11-2.0 PROCEDURES

The following procedures should be followed to collect water/product level measurements. Procedures may vary depending on the equipment used and contaminants present at the site. Site-specific conditions may warrant the use of stringent air monitoring and decontamination scenarios.

1. Record the condition of the well (protective casing, concrete collar, lock in place etc.).

2. Put on latex or other sterile gloves. Stand upwind of the well and unlock and open the well. Record all pertinent air monitoring observations (sustained, dissipating, background odor).

3. Identify the previous measuring point marking or notch on the riser or casing (if present). Record this location in the field logbook.

4. Using a previously decontaminated water level indicator (see TRC SOP No. 5.0), turn on the meter, check the audible indicator, lower the electronic probe into the well riser (with the increments visible) slowly until the meter sounds, grasp the tape with hand, withdraw the tape and lower it again slowly until the sound is again audible. Check the depth to water on the tape and record the depth to within 0.01 feet. Lower the probe again slowly and repeat the measurement for accuracy. Record the sampling location, date, time of day, and depth to water from the measuring point in the field logbook.

5. Procedures utilized during water level measurements where free-phase petroleum products are floating on the water table should be modified to include the use of the oil/water interface probe. Through the use of this probe, product thickness can be determined. Follow the steps outlined in this SOP and the manufacturer's instructions to measure product and water levels.

6. Decontaminate the probe and any obviously soiled tape with the procedures identified in TRC SOP No. 5.0.

11-3.0 QUALITY ASSURANCE/QUALITY CONTROL

The water level will be measured twice to check accuracy of first reading and thus avoid human error. All measurements and observations will be recorded in the field logbook.

11-4.0 SAFETY CONSIDERATIONS

The work site may introduce health and safety concerns. Entering the site with care and using the appropriate personal protective equipment (PPE). Prior to entering the site, each TRC staff member should read and understand corresponding Material Safety Data Sheets (MSDSs), the TRC corporate Health and Safety Plan, and any project-specific Health and Safety procedures. Compliance with all applicable PPE and other health and safety procedures presented in these documents must be a priority of each project field effort.

11-5.0 EQUIPMENT

The following list of equipment may be utilized during the conduct of water level measurements. Site-specific conditions may warrant the use of additional or deletion of items from this list.

- Electronic water level indicator.
- Tap Water.
- Alconox, Liqui-nox or other non-phosphate concentrated laboratory grade soap.
- De-ionized water and pint squeeze bottles.
- Any necessary personal protective equipment (gloves, eyewear, Tyvek® suits).
- Field logbook.
- Well keys.
- Previous measurement data (if available).
- Oil/water interface probe.
- Precision ruler.

11-6.0 TRAINING AND/OR QUALIFICATIONS

All persons performing the activities described in this SOP must have read and have an understanding of the contents. The individual must previously be instructed in the safe handling of chemicals. An understanding of project-specific plans (e.g., Field Sampling Plan, Quality Assurance Project Plan, etc.) and requirements is also recommended.

11-7.0 REFERENCES

- *A Compendium of Superfund Field Operations Methods* (EPA/540/P-87/001)

Title: Groundwater Sampling from Monitoring Wells	*Procedure Number:* No. 12.0
Project: Falcon Refinery Superfund Site, Ingleside, TX	*Revision Number:* 0.0
Reason for Revision: NA	*Revision Date:* March 2011

12-1.0 PURPOSE, SCOPE, AND APPLICABILITY

This Standard Operating Procedure (SOP) was prepared to direct TRC personnel in groundwater sample collection from monitoring wells. This guideline is primarily concerned with the collection of water samples from the saturated zone of the subsurface.

The objective of groundwater sampling is to obtain a representative sample of water from the groundwater aquifer. This requires that the water sample being collected is representative of true groundwater as opposed to stagnant water, which is contained in the well casing and associated plumbing.

12-2.0 PROCEDURES

In order to obtain a representative groundwater sample for chemical analysis it is important to remove stagnant water in the well casing and the water immediately adjacent to the well before collection of the sample. This may be achieved with one of a number of instruments, including a bailer, submersible pump, and non-contact gas bladder pump.

Equipment will be properly decontaminated (see TRC SOP No. 5.0) and calibrated prior to use. Samples will be packaged and shipped in accordance with TRC SOP No. 4.0, and a chain-of-custody completed in accordance with TRC SOP No. 3.0.

12-2.1 *GROUNDWATER SAMPLING PROCEDURES*

The following procedure should be used for collecting a groundwater sample from a monitoring well.

1. Prior to collecting water samples, place a waterproof sample label on each sample container. Include the information specified in TRC SOP No. 3.0 on each label, including:

   a. Project Name: __________ (e.g., XYZ Corporation)
   b. Sample ID: _________ (e.g. 031702-MW-18BR)
   c. Analysis required: ________ (e.g., VOC)
   d. Preservative: _________ (e.g. ICE, pH<2, HCl)
   e. Collection Time: _________ (e.g., 0930)
   f. Collection Date: _________ (e.g., 4-18-93)
   g. Initials of Sampler: _______ (e.g., RAS)

   Fill in the information with a waterproof ink pen ***before*** sample collection. This will prevent difficulty in filling out a wet label.

2. In the field logbook, note the physical condition of the well, including damage, deterioration, and signs of tampering, if any.

3. Unlock the protective cap on the well. Open the well cap. Note any unusual odors, sounds, or difficulties in opening the well.

4. Gently lower the decontaminated water level indicator (or oil/water interface probe, if appropriate) into the well to determine the depth to the static water level (and product, if applicable).

5. Purge an initial sample of water from the well using a bailer, low-flow submersible pump or other appropriate pump and record readings of water quality parameters with decontaminated instruments. The method of purging the wells will depend on the well construction, depth, and rate of recharge. Pumping purging procedures are as follows:

   a. Slowly lower the pumping equipment so that the intake is located at the midpoint of the well screen. If the water level is lower than the top of the well screen, position the pump intake at the midpoint of the standing water. The intake should be at least 1 foot above the bottom of the well to minimize mobilization of settled sediment, the risk of the pumping suction being broken, or the entrainment of air in the sample. Once the pump is secure, lower the water level indicator to monitor the water level.

   b. Commence purging at the slowest possible rate and slowly increase the speed until discharge occurs. Measure the flow rate using a plastic graduated cylinder and timepiece. Adjust the pump speed to maintain a drawdown of less than 0.3 feet, if possible. Monitor the draw down. Continue to monitor the water level during the purging and sampling. Note any flow rate adjustment(s). Monitor water quality parameters and record every 3 to 5 minutes. The well should not be pumped dry and once pumping is begun, it should not be interrupted until the entire sample volume has been collected. Collect all purge water in an appropriate container.

   c. Stop purging when the water quality parameters have stabilized. Parameters are considered to have stabilized if, over three consecutive readings, all of the following criteria are met:

      - pH ±0.1 unit,
      - Specific conductance and temperature within 3%,
      - Turbidity (if necessary to measure) within 10% for values greater than 1 nephelometric turbidity units (NTU),
      - DO (if necessary to measure) within 10%, and
      - Oxidation/Reduction Potential (ORP) within 10 mv.

   d. Disconnect the tubing from the water quality parameter measuring equipment (i.e. the flow-through cell) and collect the groundwater sample directly from the well.

6. If low flow procedures do not work because water levels are below maximum head level limits of the sampling pump (approximately 30-40 feet below the top of the well) or due to pump malfunctions, then bailing should be conducted to purge and sample the well. Bailing procedures are as follows:

   a. Conduct contamination and water level measurements as described above.

b. Use dedicated bailer or single use bailer to avoid cross-contamination from previous sampling activities. Use new nylon or polyethylene rope and discard after use.

c. Securely tie rope to bailer and the other end of the rope to the well.

d. A minimum of three well volumes (see below) should be purged from the well with readings of indicator parameters taken after removal of each successive well volume. If indicator parameters have stabilized after the removal of three well volumes (according to criteria listed above), the well should be sampled. If indicator parameters have not stabilized, a maximum of five well volumes should be removed prior to sampling. If the well is bailed dry, a sample can be collected as soon after the water level sufficiently recovers to a level that a sample can be collected.

e. Calculate well volume by multiplying the length of the water column (water level minus well depth) by 0.164 gallons/feet.

f. After the well has been appropriately purged in the manner described above, the sample should be collected by gently pouring the sample from the bailer into the sample container.

7. Collect the samples according to the following procedures.

   a. Fractions of the groundwater sample should be collected in the following order:

      i. VOCs
      ii. SVOCs
      iii. Unfiltered inorganics
      iv. Filtered inorganics
      v. Water quality parameters

   b. Using latex gloves to protect hands and prevent cross-contamination, open the sample container. During sample collection, allow the water to flow directly down the side of the sample container without allowing the tubing the touch the inside of the sample container or lid, in order to minimize aeration and maintain sample integrity. Sample containers are specified in the Field Sampling Plan.

   c. Collect samples for volatile organics first. The sample vial must contain no air bubbles after it has been capped; ensure this by turning the vial upside down and tapping it lightly. If any bubbles are observed, discard the sample and collect a new sample.

   d. Fill the remaining sample containers for all other analyses.

   e. Preserve the samples in accordance with the Field Sampling Plan.

8. In accordance with TRC SOP No. 4.0, wrap the sample containers in a re-sealable plastic bag and cool to approximately $4^{\circ}C$ with ice packs in cooler. Pad the samples with bubble wrap and/or vermiculite packing as necessary.

12-2.2 *PURGE WATER MANAGEMENT*

The purge water generated at each well should be drummed. Samples from the drums may be analyzed for characterization purposes. The drummed water must be disposed according to all applicable regulations.

12-3.0 QUALITY ASSURANCE/QUALITY CONTROL

Quality control (QC) procedures associated with groundwater sample collection include:

- Collection of equipment blanks, except when collection equipment are dedicated to use at one specific location or sample;
- Inclusion of trip blanks, for volatile organic methods only;
- Collection of field duplicates;
- Chain of custody records (see TRC SOP No. 3.0);
- Collecting adequate sample volumes for matrix spike and matrix spike duplicate (MS/MSD) analyses, as per the project plans;
- Preservatives: Physical (e.g., cool to 4°C, glass bottle) and chemical (e.g., hydrochloric acid); and
- Observance of holding time requirements.

A list of the specific QC samples and corresponding frequencies for each is specified in the Field Sampling Plan.

12-3.1 *EQUIPMENT BLANKS*

The equipment blank is a sample of analyte-free (distilled) water that is rinsed through the sampling equipment. It is collected after completion of decontamination and prior to sampling. This blank is used to document adequate decontamination of sampling equipment. Details of equipment blank collection procedure and rationale must be recorded in the field logbook in addition to the standard sample information entered (as described above). Equipment blanks are properly labeled and entered on the chain-of-custody.

12-3.2 *TRIP BLANKS*

A trip blank is an aliquot of reagent water or other neutral item (resin, filter) created in the laboratory. This aliquot is placed in the cooler and is transported with the samples going to the laboratory for analysis. The aliquot is analyzed to determine if the sample vials had been contaminated from an outside source during the bottle preparation through the time the samples were analyzed at the laboratory.

If a trip blank is not available, sampling procedures should be followed to prepare a trip blank using reagent or distilled water. Note in the field book that the trip blank was prepared in the field. The trip blank is properly labeled and entered on the chain-of-custody.

12-3.3 *FIELD DUPLICATES*

The following procedures should be used for collecting duplicate groundwater samples:

1. Each duplicate sample will be collected simultaneously with the actual sample. At the coincident step in the sampling procedures that the VOC containers are filled and sealed, the duplicate sample VOC containers will also be filled and sealed.

2. All collection and preservation procedures outlined for groundwater sampling will be followed for each duplicate sample.

12-3.4 *MATRIX SPIKE/MATRIX SPIKE DUPLICATES*

Matrix spike/matrix spike duplicate (MS/MSDs) samples are field samples into which the laboratory introduces a known concentration of a target analyte(s) into a second and third sample aliquot. The spiked sample is processed through the entire analytical procedure. Analysis of the matrix spike is used as an indicator of sample matrix effect on the recovery of target analyte(s). The following procedure describes how to collect a sample used as a matrix spike:

1. Collect sample following the above procedures, however, collect an additional 6 vials of sample. Three additional vials will be labeled with the unique identification number and a MS at the end, and three vials will be labeled with the unique identification number and a MSD at the end (see TRC SOP No. 3.0).

2. Field samples selected for matrix spikes should not have high concentrations of contaminants.

12-3.5 *SAMPLE HOLDING TIMES AND PRESERVATION GUIDELINES*

Maximum holding times and sample preservation guidelines are established for each method to reduce the chance of generating results that are not representative of the original sample due to changes in analyte concentration over time. The Field Sampling Plan specifies preparation and analysis holding times as well as preservation requirements.

12-4.0 SAFETY CONSIDERATIONS

Environmental samples may consist of, or may be preserved with, caustics and/or acids that can cause burns if the material should come in contact with the skin. The sample collection site may introduce additional health and safety concerns. Entering the site and/or the handling of samples should always be done with care and using the appropriate personal protective equipment (PPE). Prior to entering the site or handling samples or chemical preservatives, each TRC staff member should read and understand corresponding Material Safety Data Sheets (MSDSs), the TRC corporate Health and Safety Plan, and any project-specific Health and Safety procedures. Compliance with all applicable PPE and other health and safety procedures presented in these documents must be a priority of each groundwater sample collection effort.

12-5.0 EQUIPMENT

The following equipment should be used when purging and sampling a monitoring well. Site-specific conditions may warrant the use of additional equipment or deletion of items from this list.

- Field logbook and indelible pen
- Well keys
- Appropriate personal protective equipment, including gloves, safety glasses, and Tyvek (if necessary)
- Water level indicator, or oil/water interface probe (if necessary)
- Bailers and nylon line
- Pump (low-flow submersible pump, bladder pump, or other appropriate pump for low-flow sampling) and applicable battery, hose clamps, control box, compressor or nitrogen gas tank.
- Tubing (thin for putting down into well, wide for attaching to water quality parameter flow-through cell)

- Tool box, including a wrench the correct size for air regulator, wire strippers, electrical tape, Teflon tape
- Water quality parameter meter
- Pre-preserved sample containers. Alternately, a sample preservative kit (includes preservatives for each specific analysis) and empty sample containers
- Bucket
- De-ionized water for decontamination
- Paper towels
- Chain-of-Custody forms
- Custody seals
- Sample labels
- Packing tape
- Zip-lock bags
- Trash bags
- Packing materials
- Shipping coolers and ice
- Quality control samples including trip blanks and performance evaluations samples, if applicable

12-6.0 TRAINING AND/OR QUALIFICATIONS

All persons performing the activities described in this SOP must have read and have an understanding of the contents. The individual must previously be instructed in the safe handling of chemicals. An understanding of project-specific plans (e.g., Field Sampling Plan, Quality Assurance Project Plan, etc.) and requirements is also recommended. It is required that a person collecting groundwater samples for the first time, do so with supervision from an experienced sample collection specialist.

12-7.0 REFERENCES

- 40 Code of Federal Regulations (CFR) Part 136, *Guidelines for Establishing Test Procedures for the Analysis of Pollutants*

- *A Compendium of Superfund Field Operations Methods* (EPA/540/P-87/001). U.S. EPA.

- *SOP for Groundwater Well Sampling*, U.S. EPA Emergency Response Team, January 1995.

- *Low Stress (low-flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells* (U.S. EPA, July 30, 1996, Rev. 2)

- *Test Methods for Evaluating Solid Wastes Physical/Chemical Method (SW-846),* U.S. EPA. 1996.

STANDARD OPERATING PROCEDURE

Title: **Surface Water Sampling**	*Procedure Number:* **No. 13.0**
Project: **Falcon Refinery Superfund Site, Ingleside, TX**	*Revision Number:* **0.0**
Reason for Revision: **NA**	*Revision Date:* **March 2011**

13-1.0 PURPOSE, SCOPE, AND APPLICABILITY

This Standard Operating Procedure (SOP) was prepared to direct TRC personnel in surface water sampling. The Field Sampling Plan (FSP) will indicate the surface water sampling locations and reasoning based on point source discharges, non-point source discharges and type of surface water body.

Wading for surface water samples in lakes, ponds, bays and slow-moving rivers and streams will be performed with caution to minimize disturbance of sediment. All surface water samples are to be obtained from the most downstream sample to avoid sediment interference.

13-2.0 PROCEDURES

Sample selection should adequately represent the conditions of the lake, pond or bay. Identify intakes and outflows that will provide biased sample representation. The number of water sampling sites on a lake, pond, or impoundment will vary with the purpose of the investigation, as well as the size and shape of the basin. When collecting sediment samples in lakes, ponds, and bays, samples should be obtained at locations noted in the Work Plan. In all instances, the sampling locations should be properly documented with field notes and photographs.

13-2.1 *SAMPLING TECHNIQUES*

1. When collecting surface water samples, direct dipping of the sample container into the water is acceptable unless the sample bottles contain preservatives. If the bottles are preserved, then pre-cleaned unpreserved bottles should be used to collect the sample. The water sample should then be transferred to the appropriate preserved bottles. When collecting samples, submerse the inverted bottle to the desired sample depth and then tilt the opening of the bottle upstream to fill. Composting across a stream and/or water channel is typically performed using a pre-rinsed 1 to 2 L plastic bottle collecting sub-samples for final mixing sample aliquot collection. VOC's must not be collected from the compositing bucket and are sampled directly from the stream cross section.

2. Wading may disturb sediment and could result in a biased sample. Wading is acceptable if the stream has a noticeable current and the samples are collected directly into the bottle while pointed upstream. If the stream is too deep to wade or if the sample must be collected from more than one water depth, additional sampling equipment will be required. Samples should be collected approximately 6 inches (15 cm) below the surface with the sample bottles completely submerged. This will keep floating debris from entering the sample bottles. Floating debris could result in unrepresentative analytical data.

3. Teflon bailers may be used for surface water sampling if it is not necessary to collect a sample at a specified interval. A top-loading bailer with a bottom check-valve is sufficient for many studies. As the bailer is lowered through the water, water is continually displaced

through the bailer until a desired depth is reached, at which point the bailer is removed. This technique is not suitable where strong currents are encountered (because the ball may not seat effectively), or where a discrete sample at a specific depth is required.

4. A glass beaker or stainless steel scoop may be used to collect samples if the parameters to be analyzed are not interfered with. The beaker or scoop should be rinsed three times with the sample water prior to collection of the sample. All field equipment should follow standard cleaning procedures.

13-3.0 QUALITY ASSURANCE/QUALITY CONTROL

Quality control (QC) procedures associated with groundwater sample collection include:

- Collection of equipment blanks, except when collection equipment are dedicated to use at one specific location or sample;
- Inclusion of trip blanks, for volatile organic methods only;
- Collection of field duplicates;
- Chain of custody records (see TRC SOP No. 3.0);
- Collecting adequate sample volumes for matrix spike and matrix spike duplicate (MS/MSD) analyses, as per the project plans;
- Preservatives: Physical (e.g., cool to 4°C, glass bottle) and chemical (e.g., hydrochloric acid); and
- Observance of holding time requirements.

A list of the specific QC samples and corresponding frequencies for each is specified in the QAPP.

13-3.1 *EQUIPMENT BLANKS*

The equipment blank is a sample of analyte-free (distilled) water that is rinsed through the sampling equipment. It is collected after completion of decontamination and prior to sampling. This blank is used to document adequate decontamination of sampling equipment. Details of equipment blank collection procedure and rationale must be recorded in the field logbook in addition to the standard sample information entered (as described above). Equipment blanks are properly labeled and entered on the chain-of-custody.

12-3.2 *TRIP BLANKS*

A trip blank is an aliquot of reagent water or other neutral item (resin, filter) created in the laboratory. This aliquot is placed in the cooler and is transported with the samples going to the laboratory for analysis. The aliquot is analyzed to determine if the sample vials had been contaminated from an outside source during the bottle preparation through the time the samples were analyzed at the laboratory.

If a trip blank is not available, sampling procedures should be followed to prepare a trip blank using reagent or distilled water. Note in the field book that the trip blank was prepared in the field. The trip blank is properly labeled and entered on the chain-of-custody.

13-3.3 *FIELD DUPLICATES*

The following procedures should be used for collecting duplicate groundwater samples:

1. Each duplicate sample will be collected simultaneously with the actual sample. At the coincident step in the sampling procedures that the VOC containers are filled and sealed, the duplicate sample VOC containers will also be filled and sealed.

2. All collection and preservation procedures outlined for surface water sampling will be followed for each duplicate sample.

13-3.4 *MATRIX SPIKE/MATRIX SPIKE DUPLICATES*

Matrix spike/matrix spike duplicate (MS/MSDs) samples are field samples into which the laboratory introduces a known concentration of a target analyte(s) into a second and third sample aliquot. The spiked sample is processed through the entire analytical procedure. Analysis of the matrix spike is used as an indicator of sample matrix effect on the recovery of target analyte(s). The following procedure describes how to collect a sample used as a matrix spike:

1. Collect sample following the above procedures, however, collect an additional 6 vials of sample. Three additional vials will be labeled with the unique identification number and a MS at the end, and three vials will be labeled with the unique identification number and a MSD at the end (see TRC SOP No. 3.0).

2. Field samples selected for matrix spikes should not have high concentrations of contaminants.

13-3.5 *SAMPLE HOLDING TIMES AND PRESERVATION GUIDELINES*

Maximum holding times and sample preservation guidelines are established for each method to reduce the chance of generating results that are not representative of the original sample due to changes in analyte concentration over time. The QAPP specifies preparation and analysis holding times as well as preservation requirements.

13-4.0 SAFETY CONSIDERATIONS

Environmental samples may consist of, or may be preserved with, caustics and/or acids that can cause burns if the material should come in contact with the skin. The sample collection site may introduce additional health and safety concerns. Entering the site and/or the handling of samples should always be done with care and using the appropriate personal protective equipment (PPE). Prior to entering the site or handling samples or chemical preservatives, each TRC staff member should read and understand corresponding Material Safety Data Sheets (MSDSs), the TRC corporate Health and Safety Plan, and any project-specific Health and Safety procedures. Compliance with all applicable PPE and other health and safety procedures presented in these documents must be a priority of each groundwater sample collection effort.

13-5.0 EQUIPMENT

- Sampling device (Plastic bucket, pump, depth integrated sampler)
- Flow measurement device (velocity meter, survey equipment, measuring tape)
- Sampling materials (sample containers, log book, cooler, chain-of-custody)
- Camera
- Work Plan
- Health and Safety Plan

13-6.0 TRAINING AND/OR QUALIFICATIONS

All persons performing the activities described in this SOP must have read and have an understanding of the contents. The individual must previously be instructed in the safe handling of chemicals. An understanding of project-specific plans (e.g., Field Sampling Plan, Quality Assurance Project Plan, etc.) and requirements is also recommended. It is required that a person collecting surface water samples for the first time, do so with supervision from an experienced sample collection specialist.

13-7.0 REFERENCES

- 40 Code of Federal Regulations (CFR) Part 136, *Guidelines for Establishing Test Procedures for the Analysis of Pollutants*
- *A Compendium of Superfund Field Operations Methods* (EPA/540/P-87/001). U.S. EPA.
- *Test Methods for Evaluating Solid Wastes Physical/Chemical Method (SW-846),* U.S. EPA. 1996.

STANDARD OPERATING PROCEDURE

Title: **Borehole Abandonment**	*Procedure Number:* **No. 14.0**
Project: **Falcon Refinery Superfund Site, Ingleside, TX**	*Revision Number:* **0.0**
Reason for Revision: **NA**	*Revision Date:* **March 2011**

14-1.0 PURPOSE, SCOPE, AND APPLICABILITY

This Standard Operating Procedure (SOP) was prepared to direct TRC personnel in common techniques for the abandonment of boreholes. The method of borehole abandonment selected will be dependent on a number of factors including regulatory guidelines, depth to groundwater, presence of contamination, confining layer presence and/or physical setting. The Work Plan guiding the activities will indicate which method of borehole abandonment is required.

Boreholes need to be abandoned and sealed properly to prevent surface water entry to the groundwater regime, to eliminate any physical hazard, and to prevent/protect groundwater movement from one aquifer to another.

14-2.0 PROCEDURES

14-2.1 *BENTONITE CHIP BACKFILL*

Employed when working above or slightly into groundwater.

- Excess cuttings are drummed for disposal or have been spread at ground surface.
- The depth of the borehole is measured and recorded.
- Bentonite chips are dropped into the borehole as hollow stem augers are removed, or after the boring equipment has been removed from the borehole
- Sufficient water will be added to hydrate bentonite chips as they are placed.
- The bentonite chip backfill will be extended to within 1 foot of ground surface, the final borehole space will be backfilled with native soil and mounded slightly to allow settlement and promote surface water runoff away from the boring. Alternatively, the borehole cuttings may be mixed with bentonite to complete abandonment.
- Borehole abandonment will be documented in field records.

14-2.2 *CEMENT/BENTONITE GROUT BACKFILL*

Cement bentonite and or grout are typically used when working below the groundwater, or in an area where a confining layer exists. The following procedures will be used:

- The final depth of borehole will be measured and recorded.
- The volume of grout required will be calculated.

- A grout mix of one bag Cement and three pounds of bentonite with approximately 7 gallons of clean water will be prepared.

- Using a tremie tube, the mixture will be placed at the base of the borehole. The grout will be pumped until observed at the required elevation. The tremie tube will be raised as the grout level rises.

- The bentonite/grout backfill will be extended to within 1 foot of ground surface. The final borehole space will be backfilled with native soil and mounded slightly to allow settlement and promote surface water runoff away from boring.

- Borehole abandonment will be documented, noting depth of borehole, volume of grout used and mix ratio.

14-2.3 *CLEANUP*

The area around the borehole will be cleaned of any investigation related materials.

14-3.0 QUALITY ASSURANCE/QUALITY CONTROL

All data must be documented on field data sheets or within site logbooks. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

14-4.0 SAFETY CONSIDERATIONS

The work site may introduce health and safety concerns. Entering the site with care and using the appropriate personal protective equipment (PPE). Prior to entering the site, each TRC staff member should read and understand corresponding Material Safety Data Sheets (MSDSs), the TRC corporate Health and Safety Plan, and any project-specific Health and Safety procedures. Compliance with all applicable PPE and other health and safety procedures presented in these documents must be a priority of each project field effort.

14-5.0 EQUIPMENT

The monitoring well installation/drilling subcontractor will need a copy of the Field Sampling Plan, Quality Assurance Project Plan, and/or appropriate health and safety gear. The subcontractor will provide all additional equipment and materials.

14-6.0 TRAINING AND/OR QUALIFICATIONS

All persons performing the activities described in this SOP must have read and have an understanding of the contents. An understanding of project-specific plans (e.g., Field Sampling Plan, Quality Assurance Project Plan, etc.) and requirements is also recommended.

14-7.0 REFERENCES

- *A Compendium of Superfund Field Operations Methods* (EPA/540/P-87/001). U.S. EPA.

STANDARD OPERATING PROCEDURE

Title: **Investigation-Derived Wastes (IDW)**	*Procedure Number:* **No. 15.0**
Project: **Falcon Refinery Superfund Site, Ingleside, TX**	*Revision Number:* **0.0**
Reason for Revision: **NA**	*Revision Date:* **March 2011**

15-1.0 PURPOSE, SCOPE, AND APPLICABILITY

This Standard Operating Procedure (SOP) was prepared to direct TRC personnel in common techniques for characterization of investigation derived waste (IDW) for disposal purposes. IDW may consist of soil cuttings, groundwater, personal protective equipment and disposal equipment.

Investigative soil and groundwater will not be considered a listed waste unless there is specific knowledge concerning the chemical source as a listed waste, chemical origin and timing of chemical introduction to the subsurface. Consequently waste sampling and characterization is performed to determine if the wastes exhibit one or more characteristics of hazardous waste.

The disposal of soil cuttings and/or purged groundwater must be reviewed on a case by case basis prior to initiation of field activities.

15-2.0 PROCEDURES

The procedures for handling and characterization of field activity generated wastes are:

15-2.1 *SOIL*

- Soil removed from boring activities and well construction tasks will be contained within an approved container, suitable for transportation and disposal.

- Once placed into the approved container, any free liquids (i.e., groundwater) will be poured off for disposal as waste fluids, or solidified within the approved container using a solidification agent such as speedy-dri (or equivalent). No free liquid as determined by the "paint filter test" shall be present.

- Contained soils will be screened for the presence of Volatile Organic Compounds (VOCs), using a Photo-ionization detector (PID); this data will be logged for future reference.

- Once screened, full and closed, the container will be labeled in accordance with the Facility labeling requirements and placed into the Facility container storage area. At a minimum the following information will be shown at each container label: date of filling/generation, Facility name, source of soils (i.e., borehole or well), and Facility contact. If necessary, the exterior of the container will be cleaned to remove any lose dirt/cuttings.

- Prior to container closure, representative samples from a percentage of the containers will be collected for waste characterization purposes and submitted to the project laboratory.

15-2.2 *GROUNDWATER*

- Well construction development, purging and sampling groundwater which requires disposal will be contained. Containment may be performed in 55-gallon drums, tanks suitable for temporary storage, or if large volumes of groundwater are anticipated, in drilling "Frac" tanks. In all cases the container/tank used for groundwater storage will be clean before use.

15-2.3 *DECON WATER*

- Decon waters and/or fluids will be segregated, contained and disposed accordingly.

- Decon waters may be disposed of with the contained groundwater once analytical results have been acquired.

15-3.0 QUALITY ASSURANCE/QUALITY CONTROL

All data and events must be documented on field data sheets or within site logbooks. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan.

15-4.0 SAFETY CONSIDERATIONS

Several disposal options exists for spent PPE/DE generated from investigation tasks. The options typically employed are:

- Immediately disposed of within on-site dumpster/municipal trash; or

- If known to be contaminated with RCRA hazardous waste, dispose off-Site at a RCRA-Subtitle C facility, or TSCA facility, if applicable; or alternatively, decontaminate PPE/DE and dispose on-site within dumpster/municipal trash; or contain and store until the final remedy is implemented.

The work site may introduce health and safety concerns. Entering the site with care and using the appropriate personal protective equipment (PPE). Prior to entering the site, each TRC staff member should read and understand corresponding Material Safety Data Sheets (MSDSs), the TRC corporate Health and Safety Plan, and any project-specific Health and Safety procedures. Compliance with all applicable PPE and other health and safety procedures presented in these documents must be a priority of each project field effort.

15-5.0 TRAINING AND/OR QUALIFICATIONS

All persons performing the activities described in this SOP must have read and have an understanding of the contents. An understanding of project-specific plans (e.g., Field Sampling Plan, Quality Assurance Project Plan, etc.) and requirements is also recommended.

15-6.0 REFERENCES

- *A Compendium of Superfund Field Operations Methods* (EPA/540/P-87/001). U.S. EPA.